SHAPING OUR FATE: ANALYZING CIRCULAR ECONOMY PRINCIPLES IN CORPORATE SUSTAINABILITY STRATEGY AS A CRITICAL CLIMATE SOLUTION FOR THE APPAREL INDUSTRY

by

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Apparel is one of the most polluting industries in the consumer goods sector. From microplastic pollution in waterways, to greenhouse gas emissions, and even the release of toxic chemicals into the habitats of biodiverse life, the production and consumption of garments is an extremely hazardous process in its current form. The circular economy is a transformational concept that reimagines how we consume clothing; it proposes alternative business models whereby companies can generate revenue without relying on the extraction of raw materials or the use of nonrenewable resources. However beneficial they may be, circular practices are contradictory to the way most apparel companies currently operate, making it a difficult scheme to implement. Not to mention, the textile value chain is a complexity in and of itself that challenges the prospect for change. This thesis will investigate the current efforts that resemble circularity strategy made by apparel companies and assess the current state of implementation of the economic model. Materials selection, resale, and recovery are highlighted as a few of several practices that exist in an entire toolkit for integrating circularity and addressing shortcomings of current linear business operations in apparel. Specifically, this study will examine the strategies mused to address material selection, resale, and recovery of goods by Patagonia, REI Co-Op, and Cotopaxi. In this piece, I suggest that circularity should be a common goal of all stakeholders in

apparel to target the pollution caused by the industry globally. Though it remains unclear if 100% circularity is even possible to achieve – largely due to current consumption patterns and the complications of processing technical materials – it is still something that the industry should collectively work towards to reduce the environmental footprint of apparel.

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Table of Contents

List of Figures

List of Tables

Introduction

The Problem with Apparel

Our planet's ability to support human life is rapidly diminishing. Currently, our economic system is not designed to operate within natural environmental limits – in fact, economic growth is linked to ecological degradation. The production, consumption, and disposal of consumer goods has placed stress on the environment, exceeding the limits of the Earth to not only provide resources, but to uptake waste, process it, and regenerate itself (38).[1] And our window to enact change is immediate; we don't have forever to figure out how to operate within our planetary boundaries, how to decrease our footprint, or how to safeguard the survival of humankind and other non-human life with which we coexist. And better yet, we can't seem to collectively prioritize any of this at the expense of not purchasing new goods constantly.

Right now, most consumer products are created in a take-make-waste system, where resources are extracted, turned into goods, and thrown out after usage. This is called a linear economy, as materials are going down the line from production → consumption → waste, or in other words, directly from the planet to the consumer to the landfill. A linear business model, which is ordinary in apparel, is the ultimate driver of pollution because it does not create a plan for products in their end-of-life stage, nor holds companies accountable to deal with them. Not to mention, linear models constitute "an industrial system largely reliant on fossil fuels" (308)[2]. The *circular economy* is an approach that addresses the shortcomings of production and consumption in the linear model. It functions as a closed loop system housed within the limits of

[1] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." *Ecological Economics*, vol. 143, 2018

[2] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." *Journal of Industrial and Production Engineering*, vol. 33, no. 5, 2016

the environment, countering the contemporary notion that the environment exists inside a boundless economic realm. The circular economy offers a way out of the industry's current dependence on resource extraction for revenue growth by transforming all three stages of the linear model: take – extraction, make – production, and waste – disposal.

Apparel is just one industry of many in dire need of change; it is the second most polluting industry worldwide, falling just behind big oil (83).[3] The environmental impacts of a garment primarily occur in distinct lifecycle stages: raw materials extraction, manufacturing, goods movement, consumer care, and end of life management. In the manufacturing stage alone, copious amounts of pollutants are released into ecosystems, waterways, and the atmosphere. Besides manufacturing, the transport, laundering, and disposal of clothes create abundantly more environmental damage (85).[4]

Globally, over 80 billion pieces of clothing are purchased each year, and less than 1% of that volume is turned into new clothes.[5] In fact, the average American discards 82 pounds of clothing waste each year.[6] This is primarily due to the rise of fast fashion – a term used to describe the modern way that clothing is consumed. Some defining characteristics of fast fashion include production schemes in low-cost economies globally, extremely low price-tags, new items being released weekly in mass volumes, and cheaply made garments that necessitate new purchases frequently.[7] Though fast fashion can be considered its own market segment, the fast fashion model has blended into other market segments of apparel. It has become a familiar way

[3] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." *Scrivener Publishing*, 2020.
[4] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[5] "Circular Economy Introduction." Ellen MacArthur Foundation, n.d.
[6] The True Cost. Directed by Andrew Morgan, Untold Creative and Life is My Movie Entertainment, May 2015. https://truecostmovie.com/
[7] The True Cost. Directed by Andrew Morgan, May 2015.

of consumption for many people in Western society generally, both within and outside of apparel.

Waste from textiles and apparel can be broken down into three key categories: pre-consumer waste, post-industrial waste, and post-consumer waste. Pre-consumer waste is generally thought of as what doesn't make it past manufacturing—things like fabric scraps, rejected cloths, and surplus inventory (29).[8] In comparison, post-industrial waste is created at specific touchpoints in the production process. An example of this would be chemicals from garment dyes that are dumped into waterways. The third category, post-consumer waste, is what consumers may be most familiar with: household apparel items that are discarded due to loss of quality, aesthetic, practicality, need, and so on. All three types of textile waste are of concern, each with their respective environmental impacts, confounding to demonstrate that waste is made in every step of the textile product lifecycle (28).[9]

Because the apparel industry has such a substantial environmental impact, it also has a great opportunity to slow the trajectory of climate change and pollution. Frankly, "the earth is shrinking, and at an accelerating pace. Deserts are expanding, the sea level is rising, the population is growing, per capita consumption is increasing, the volume of livestock and cattle is growing, and biodiversity is depleting at ever faster rates" (38).[10] With the right tools, the apparel industry can begin to transition away from linear business models and, in the process, minimize its environmental footprint while adding value for businesses, customers, and stakeholders alike.

[8] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[9] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[10] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

Circularity: A Potential Solution

The environmental and social costs associated with fast fashion are immeasurable. However, the price of most clothing we consume does not account for the environmental and social impacts created at each stage of the linear model. These costs are instead externalized; the burden is placed on the environment to provide resources and house waste, as well as on the people who are underpaid to make the clothes and live in polluted environments that compromise their health. To transform the impacts of apparel, we need strategies to quantify and address pre-consumer, post-industrial, and post-consumer waste. These undertakings can help our economy implement systems that incentivize less harmful decisions, keep existing quantities of clothes out of landfill, and comprehensively recycle unusable materials. The circular economy model seeks to transform the contemporary linear system through its principles: [1] eliminating waste and pollution, [2] circulating products and materials, and [3] regenerating nature.[11]

1. *Eliminate Waste and Pollution*

A clothing garment requires substantial amounts of raw materials, water, energy, and human labor – not to mention chemicals, greenhouse gas emissions, and other harmful byproducts. Extending the lifetime of a garment is one way to realize the maximum value of all its embodied resources.[12] To curtail waste and pollution, the first circular economy principle emphasizes products with longevity, or those that are designed to be durable and kept in use for as long as possible. Keeping clothes in use for longer would mean expanding services like rental, repair, resale, sharing, or swapping. The extraction of raw materials within the linear model is

[11] "Circular Economy Introduction." Ellen MacArthur Foundation, n.d.
[12] "Circular Economy Introduction." Ellen MacArthur Foundation, n.d.

thus addressed by extending the lifetime of products and repurposing materials to decrease the demand for new raw materials.

2. *Circulate Products and Materials*

The circular economy model incentivizes apparel companies to think sustainably starting with the fundamental design of their product. Circular apparel should be designed for easy repurposing into a new item or for easy recycling into new material at the end of its life. Textiles that would otherwise be wasted can now re-enter the system as recovered fabric swatches or re-spun material, while components such as zippers and buttons can be reused in the manufacture of new clothes. If the waste stream is tapped into as a resource, more clothing would contain recycled content. This circulation of existing materials creates an environmental advantage as the resource depletion and byproducts of manufacturing are eliminated. [13]

3. *Regenerate Nature*

Regenerating nature is the third principle of the circular economy. Seeking to have a minimal environmental impact, circular fashion employs measures such as abandoning harmful chemicals and utilizing renewable energy. It can even mean sequestering carbon in products.[14] The other principles of eliminating waste and circulating materials also supplement this goal, to enhance and rebuild ecosystem resilience.

Where We Are Now

Currently, most businesses and industry actors in global apparel markets have no responsibility for what happens to consumer goods once the products leave the company's hands.

[13] "Circular Economy Introduction." Ellen MacArthur Foundation, n.d.
[14] "Circular Economy Introduction." Ellen MacArthur Foundation, n.d.

With the circular economy, a newfound responsibility for end-of-life products means an opportunity for companies to minimize harm caused by the apparel industry, not to mention realize numerous benefits such as eco-efficiencies and cost reduction. However, the state of circularity in apparel today is unclear. Like the rise of 'sustainability' as a buzzword, the circular economy is a concept that has recently caught on in sustainable apparel related conversations.

Brands like Levi's and the North Face are coming out with "circular" clothing lines and the concept is being generally discussed with the assumption that everyone knows what it means. Despite any efforts to slowly transform the sustainability of apparel products, "a fully circular system is more of a hypothetical construct at this point" and circular products "do not yet exist at scale" (18).[15] Our existing apparel economy is not made for products to be kept in the loop and there are even parts of the system that rely on the obsoleteness of goods (7).[16] There is an industry-wide struggle to figure out best practices for implementing circular strategies and systems.[17] Where do we begin, and who starts?

Considering circularity as a new strategy implies that we are making a transition, doing something different than the apparel industry has known in the past. However, there is a general vagueness in the way circularity is discussed, lacking transparency when it comes to key pieces of circular strategy. Presently, many companies fail to clearly articulate what circularity looks like for them, in its entirety, and it seems as though there is a lack of consensus on an industry-wide level. Though many stakeholders are coming into aligned perspectives about a company's role and the importance of sustainability, "mutual suspicion" can create mistrust among

[15] "Circular Electronics System Map: An Industry Blueprint for Action." Circular Electronics Partnership, Accenture, n.d.
[16] Braungart, Michael, and William McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. North Point Press, 2013.
[17] J. Taylor Sloan (personal communication), 2 Feb 2023.

businesses, investors, and customers (4).[18] This makes businesses wary of communicating with stakeholders about their sustainability efforts, fearing to come under scrutiny for well-intended actions toward progress (4).[19] Aside from opacity in circularity discourse, ambiguity in implementation, and challenges to sustainability related communication, there exists an array of technical problems that create additional barriers to circularity. Current systems to recover and recycle goods are unequipped, technologically, to handle the quantity of waste that exists and the materials that make up that waste (54).[20]

This thesis aims to explore the opportunities that exist to create more positive impact socially, economically, and environmentally. It will evaluate evidence of circular strategies showing up in current business models in apparel and analyze if that evidence points to business value for companies in pursuit of sustainability. It will also consider the prospects for transitioning to a circular apparel economy and the barriers to doing so. In the spirit of sustainability strategy, the circular economy is highly applicable to the apparel industry as one approach to tackling issues of waste and overconsumption.

[18] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[19] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[20] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.

Methodology

Research Objectives

This study seeks to explain how the circular economy model can be applied to a specific context. It considers what circularity in apparel looks like, what it implies about the currently predominant business models, and what barriers exist should apparel seek a systemic transition to a circular economy. To create a balanced structure for analysis, I have focused on three elements of circularity: product materials in the design stage, resale business in the life-extension stage, and textile recycling in the recovery stage.

My research takes a three-pronged approach to evaluating the opportunities and limitations in each component of circular strategy – materials, resale, and recycling. I start by inquiring about the environmental benefit and rationale of each approach as singular components of circularity. I then seek out evidence from three case study companies, pointing to where circular strategies or similar practices show up in business models in the real world. Lastly, I draw analysis from that evidence and point out where there appears to be business value in pursuing such circular strategies.

Research Methods

Literature Review

First, I conducted an in-depth literature review of the circular economy idea. Where did it originate from? How has it been applied in different industry contexts outside of apparel? How do different entities define circularity and describe its key components, benefits, and limitations? By reviewing academic literature, books, and content from non-profit organizations committed

to industry change, I gained a firm understanding of the circularity concept and how it applies in different industries, with a focus on apparel.

Company Case Studies: Circular Sustainability Strategy

Several companies in the outdoor gear industry were selected for a competition analysis, in which their sustainability efforts were evaluated and benchmarked. This study evaluates Patagonia, REI Co-op, and Cotopaxi – all industry peers in outdoor gear and apparel. As a set of industry leaders, these companies were analyzed for any efforts that reflect circular economy strategies across materials, resale, and recycling, even if they aren't marketed as circular practices.

The selected companies are similar when it comes to market segment and product offerings. Though, each was chosen for having a slightly different profile than the rest. Patagonia is a long standing, established brand that is bigger in terms of its global reach; REI is both a brand and a retailer simultaneously, selling its own products as well as those from hundreds of other gear companies; and Cotopaxi is a smaller, newer brand that has come into the apparel scene after conversations around sustainability began.

As the selected brands make products for outdoor pursuits, Patagonia, REI Co-op and Cotopaxi are more likely to have environmentally inclined consumer bases compared to other segments of apparel. This is important for the nature of my study because consumers that demonstrate a care for the environment are likely to demand better products and be willing to participate in a collaborative sustainability system like circularity. This should also expand the ability of brands to be progressive on these topics.

All three case companies are working with the same third-party company, Trove, to implement take-back networks for reselling used goods.[21] Because the study evaluates companies operating the same type of resale business model with the same provider, the research also explores how these programs differ, how they seek to incentivize the rest of the apparel system to participate, and what other life-extension efforts exist outside of resale. My research also investigates the prioritization of certain design principles over others; for example, in practice, is there more emphasis on utilizing recycled materials or creating durable, long-lasting products even if they use virgin materials?

Company Case Studies: Product Materials Analysis

Another angle of analysis will assess current circularity practices at the product level. This section examines the impact of materials selection, considering how specific types of apparel products may be fit for circular design and other strategies. My research uses two different garments as a lens to evaluate the efforts of all three case study companies: a t-shirt in the biological nutrient cycle and a rain jacket in the technical nutrient cycle. The product analysis is a useful avenue for evaluating corporate strategy in practice, since all case study companies make similar claims about the sustainability of their product selection and overarching goals as a company.

As common, everyday types of apparel that most people own, wear, and cycle through, the two selected garments in the product analysis are popular items made by all three case study companies. Taking both products and plugging them into each company's circularity strategy will examine how different material inputs may alter the circularity process or require distinct metrics. The comparison will be dually helpful in examining if a product lifespan, which is

[21] "Our Partners." Trove, n.d., https://trove.com/partners/

different for a t-shirt versus a rain jacket, influences the prospect of achieving circularity. Analyzing these two products should also provide insight into the company's intent for managing end-of-life materials. If a company offered multiple products, the specific garments selected from each company was determined by order of precedence in the online search results and by volume of reviews.

Expert Interviews

As part of my study, I interviewed multiple experts whose professional work involves sustainability and circularity in apparel. These figures were contacted for in-depth conversations about the current state of the industry and mainstream practices being utilized in the circularity space. This method aims to gather perspectives from behind the scenes to overcome the barrier posed by using voluntarily, self-disclosed information from case companies. Many of the interviewees are employed by consulting firms or third-party companies working directly with big-name apparel brands to implement sustainability initiatives. The interviewees were asked questions according to four main categories: the circularity concept, pursuit and implementation of circular strategies, product level design choices, and next steps for the industry.

Limitations

A significant limitation of this study is that secondary research utilizes sustainability information that has been voluntarily self-reported by apparel companies. This could potentially undermine credibility of the data since there is no standardized, regulated, nor mandatory climate disclosure framework as of now. As circularity is a recent pursuit, the only accessible information about the case companies' circularity strategy and adjacent practices is that which has been disclosed publicly. It is likely that these companies are pursuing research and

development of circular products behind closed doors. This study attempts to fill any informational gaps by interviewing experts currently working across the industry.

Literature Review

The Circular Economy Concept

Circular Economy Purpose

The circular economy is defined as "an economic model aimed at the efficient use of resources through waste minimization, long term value retention, reduction of primary resources, and closed loops of products, product parts, and materials within the boundaries of environmental protection and socioeconomic benefits."[22] It draws inspiration from a set of scientific ideas including biomimicry, natural capitalism, industrial ecology, industrial symbiosis, eco-efficiency, and more (39).[23] By examining the movement of resources and energy between humans and the environment, the circular economy idea also takes inspiration from concepts like industrial metabolism (308).[24]

The principal idea that the circular economy builds upon is decoupling economic growth and development from the consumption of nonrenewable resources.[25] To accomplish this, the model seeks to mimic the closed loop cycles of nature, in which all matter is constantly being generated, used, and regenerated by different parts of a system. A circular economy "limits the throughput flow [of materials] to a level that nature tolerates and utilizes ecosystem cycles in economic cycles by respecting their natural reproduction rates" (39).[26] The model works together with natural systems of production and waste processing, seeking to respect environmental thresholds by maximizing the utility value from resources we have already extracted.

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[22] Morseletto, Piero. "Targets for a circular economy." Resources, Conservation and Recycling, vol. 153, 2020, 104553, ISSN 0921-3449, https://doi.org/10.1016/j.resconrec.2019.104553.
[23] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[24] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018
[25] "The Butterfly Diagram: Visualizing the Circular Economy." *Circular Economy*, Ellen MacArthur Foundation, n.d.
[26] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

Circular Economy Principles and Objectives

The foundational principles to a circular economy are to [1] eliminate waste and pollution, [2] circulate products and materials, and [3] regenerate nature.[27] Some key strategic elements that aim to accomplish these goals are prioritizing regenerative resources, stretching the lifetime of goods at their highest value, and using waste as a resource.[28] Moreover, a circular economy seeks to achieve positive environmental, economic, and social outcomes.

The environmental objective of a circular economy is to reduce the output of waste, pollution, and emissions, while also reducing the input of energy, natural resources, and virgin materials (41).[29] The economic objective of a circular economy is to reduce the cost of materials, energy, and waste management while innovating new designs or technology, creating market opportunities, and avoiding the PR risks associated with negative externalities. Lastly, the social objective of a circular economy is to enhance communities by transitioning from consumer culture to a sharing economy (41).[30]

Circular Economy Significance

The circular economy can be thought of as a means of transactions in which all stakeholder groups are collaboratively "engaged in a sustainable value system" (43).[31] The emphasis here is on the notion of value creation. A sustainable value system can be thought of as "a delightfully diverse, safe, healthy, and just world with clean air, water, soil and power – economically, equitable, ecologically, and elegantly enjoyed" (12).[32] To get there, perceptions of

[27] "What is a circular economy?" Circular Economy Introduction, Ellen MacArthur Foundation, n.d.
[28] "The Key Elements of the Circular Economy Framework." *Circle Economy*, n.d.
[29] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[30] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[31] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[32] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.

value and metrics of growth in our current economic system must be reimagined. The current relationships between nature, customers, markets, and growth that engage in value creation must be transformed to "recreate development and economy together with the environment and society" (36).[33]

The circular economy speaks to our current systems of production by proposing alternative means to generate revenue – means that don't depend on wreaking environmental havoc through the dependence on raw materials and waste generation, like a linear economy does. In short, "a simple and logical answer to the problem[s] of the linear flow model is its reverse; a cyclical flow of materials and energy" (38).[34] A circular economy proposes an expansion of the traditional "reuse, reduce, recycle" idea of conserving goods to what is called the 10R framework: refuse, reduce, rethink, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover.[35]

Apart from production and revenue, the circular economy also proposes a new way of organizing consumption called a sharing economy. As opposed to individual ownership and consumption, in a sharing economy "user groups and communities [are] sharing the use of the function, service, and value of physical products." [36]

It can also be argued that expanding our culturally dependent definition of value to exceed monetary value is necessary to change our perspectives on consumption. Factoring in a more-than-financial value requires cooperation that cannot be accomplished by a single economic actor; instead, it further underscores the need for "a new way of organizing between

[33] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[34] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[35] "The Key Elements of the Circular Economy Framework." *Circle Economy*, n.d.
[36] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

people and institutions" (2).[37] Reframing the idea of value creation and renegotiating relationships between industry actors can help aid the transitions in production and consumption that are conducive to a circular economy.

Circular Business Models

Circularity is an overarching strategy that can be deployed using several tools and initiatives. Some typical characteristics of a circular economy include the use of green technology, extending the lifespan of products, maintaining the quality of circulating products or materials, and phasing out negative externalities that create socio-environmental burden (37).[38] However, incorporating these practices has not been common for most consumer goods companies, historically. Such alternatives to the predominant linear business model provide insight into how business operations can be successful in a circular economy. There are three central aims for operating circular business models: resource efficiency, waste reduction, and waste recovery.

Circular business means aiming to prolong the product lifetime by creating durable, high-quality products and offering extended warranties. There is an emphasis placed on longevity of goods in order to increase the amount of uses per user and decrease overall consumption (313).[39] Circular models also provide services that negate the ownership of goods. Think of laundromats or car leasing, in which the car or laundry machine is paid for and utilized but not owned by its user (313).[40] This type of operation relies on the sharing of goods to decrease the number of overall products that exist. The purpose of increasing the amount of uses per user, users per

[37] Ly, Bora and Tan, Albert W. K. "Competitive advantage and internationalization of a circular economy model in apparel multinationals." *Cogent Business & Management*, vol. 8, no. 1, 2021
[38] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[39] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018
[40] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018

product, and of providing services beyond the goods themselves, is to extend the value of resources in as many applications as possible, for as long as possible, and to retain the embodied resources that go into making a product.[41]

Aspirations, Outcomes, and Advantages of the Circular Economy

With goals to reduce waste and pollution, circular strategies can contribute to decarbonizing the economy. Anthropogenic sources of carbon dioxide emissions have proven the primary driver of climate change, so environmental management efforts have come to identify carbon as a critical resource. Economic development and industrial processes are key causes of carbon emissions, yet they present an opportunity for change–sustainable development.

Historically, we have been effective at extracting carbon and finding uses for it, but we have been failing to capture that same carbon after its extraction and use phase (37).[42] Authors of Cradle-to-Cradle, Braungart and McDonough, argue that "humans don't have an energy problem. Energy is abundant, what humans have is a materials-in-the-wrong-place problem" (38).[43] They go on to note that the value of carbon, as a resource, is in capture rather than trade (39).[44] Looking to our natural world for guidance, we can see that carbon capture has been an important process underscoring nutrient cycles for millions of years (39).[45] To reduce carbon dioxide emissions and slow the trajectory of climate change, the circular economy promises to decrease the burden on natural carbon sinks by capturing, retaining, and circulating it in consumer goods (40).[46]

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[41] "Business and the Circular Economy." *Business*, Ellen MacArthur Foundation, n.d.
[42] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[43] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[44] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[45] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[46] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." *Ecological Economics*, vol. 143, 2018

The circular economy also proposes a solution to reduce environmental pollutants generally, aside from carbon and other greenhouse gas emissions. When it comes to material selection, the circular economy focuses on opportunities to create a "positive footprint," rather than looking for places to reduce an already negative impact (35).[47] If we choose materials that are non-toxic, regenerative, and renewable for apparel, we can create a chain of positive impacts: material selection can determine whether clean or contaminated water exits a factory, whether protective gear is needed for employees, whether storage space is full of chemicals, and whether decomposing fabric trimmings will nurture or poison local gardens (72).[48]

The circular economy presents many business advantages for companies who choose to take on circular initiatives, though sustainability efforts at the corporate level have been misperceived as costly, burdensome, and even contrary to the purpose of a business. One of such advantages is the cost savings that occur. On the input side, using materials that already exist will lessen the demand for, and associated costs with, resources and energy. Cost reductions will also occur on the output side. The costs associated with dumping waste and emissions–from landfill fees, to taxes, to environmental legislation–will be avoided by tapping into waste streams and looping discarded materials back into the economy (40).[49] In a circular system, the cost of secondary materials should be lower than virgin materials since everything is optimized to maintain value (21).[50] Not to mention, the reuse of products will boost company perceptions in a landscape that is characterized by increasing consumer demand for eco-friendly goods coupled with greenwashing (41).[51]

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[47] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[48] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[49] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[50] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[51] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

One of the leading advantages of circular business practices is the ability for companies to generate revenue without manufacturing new goods.[52] Finding new streams like resale, rental, repair, and repurposing to sell a service enables a business to generate additional profits from the same product multiple times over.[53] Service-oriented business models rely on long-term relationships which enhance value for the customer and increase loyalty for the business. In the context of apparel, additional services like customization and tailoring are other ways that companies can develop additional revenue streams.[54] In this pursuit, companies are much closer to decoupling their revenue from raw material production, which will increase their resilience in an uncertain future that may face increased regulation and shortages of non-renewable resources. In addition to increased preparedness, companies can also gain a competitive edge and opportunities for unique brand positioning with circularity.

Lastly, the business world has a unique opportunity to be at the forefront of cultural shifts, responding to changing consumer demands at a much faster rate than the policy world can respond with regulation. Involvement from the corporate world in the transition to a circular economy may cultivate increased participation from other organizations, stakeholders, and policy-making groups and unite them in this sustainability effort (37).[55]

Drawbacks, Challenges, and Barriers of the Circular Economy

Conceptually, the circular economy addresses all the major pitfalls of the apparel industry—environmentally speaking. In practice, however, the concept is not as straightforward. A circular economy relies on infrastructure that may not be in place and works against current

[52] T. Hill (personal communication), 14 Apr 2023.
[53] "Business and the Circular Economy." *Business*, Ellen MacArthur Foundation, n.d.
[54] "Business and the Circular Economy." *Business*, Ellen MacArthur Foundation, n.d.
[55] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

systems that are not made for the continuous reuse of materials. There are some key limitations of the model that need to be addressed for it to adequately function as a governing economic model in any industry.

For starters, the circular economy has very wide boundaries–potentially too big of boundaries (41).[56] Many multinational corporations dominate consumer goods industries and these companies operate very complex, multi-tiered supply chains across the globe. The size of global supply chains means that more and more actors will need to be on board with circular change. Additionally, having supply chains of such a large scale running on fossil fuel energy implies that circular economies can only be successful on a small, local or regional scale until renewable energy is employed more universally (42).[57] Not only that, but these massive supply chains are only constructed to distribute goods, not take them back.[58]

Besides the challenges caused by scale and supply chain infrastructure, it is worth noting that the very nature of global economic trajectory is an obstacle itself. Though a circular economy seeks to decouple environmental damage from economic growth, it cannot accomplish this if consumption demands exceed environmental boundaries. A "cyclic flow does not secure a sustainable outcome" on its own, but it calls for a decreased pace of consumption in conjunction with circular practices (42).[59] It is likely that resource use in the global economy will continue increasing over the next several decades. Circular practices may prove ineffective at diverting waste and pollution if the unsustainable resource use and the "growth of the physical scale of the total economic system is not checked" (43).[60]

[56] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[57] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[58] "Circular Economy Introduction." Ellen MacArthur Foundation, n.d.
[59] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[60] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

Diving deeper into the circular economy concept itself, there are additional limitations concerning the model's targets and metrics. Specific solutions, including recycling and resource efficiency, are commonly prioritized over other targets. Even so, there are problems that exist with recycling solutions which will be addressed in the coming sections. It is dually important to note that other strategies like longevity, remanufacturing, and material value retention are equally important aspects that must be factored into circular targets as well.[61]

Whatever the targets may be, the circular economic model is limited by having unclear metrics or misaligned units of measurement (41).[62] A predominant metric that many actors in apparel use to indicate success is the volume of sales.[63] Measuring aspects like sales volume is contradictory to circular economy principles for success because it relies on customers to cycle through garments quickly, diminishing the merit of reuse. Frameworks like Circulytics exist to establish key themes and indicators for circularity on a company-wide level. However, tools like this, that do include adequate performance metrics for quantifying circularity, are not yet implemented on a substantial scale.

Apparel, among other industries for consumer goods, also faces the threat of problem displacement with sustainability action (42).[64] When problems are addressed to create positive economic, social, and environmental outcomes in one location, that burden of negative externalities is shifted elsewhere (42).[65] Since most consumer goods industries have multinational corporations operating in global markets, the largest social and environmental burdens have been disproportionately placed on developing countries.

[61] Morseletto, Piero. "Targets for a circular economy." 2020.
[62] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[63] "Business and the Circular Economy." Business, Ellen MacArthur Foundation, n.d.
[64] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[65] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

Circular Electronics Model

Accenture, a global consulting firm, has conceptualized a circular economic system in the context of the technology industry. They have selected this model as a solution to transform the way electronics are produced, used, and managed across their value-chain and lifecycle. This study found several indicators of success across the design, life-extension, and recovery of circular goods.

In the design stage, there is a clear need for industry-wide standards and processes for verifying circular resources (23).[66] Materials standardization will drive transparency and innovation, foster alignment on acceptable substances, and create reliable supplies, prices, and incentives for secondary materials (22).[67] When it comes to extending the lifetime of products, Accenture's key finding is that the purpose and mission of a company should be consistent with principles of the circular economy (24).[68] Accordingly, a company's purpose can be used to guide the decision-making, goal setting, data monitoring, and reporting towards circularity. In terms of recovery, this study found the most critical element to be constructing a wide-spread, optimized collection network. There must be reverse logistics in place to facilitate the take-back, processing, and reuse of goods and materials (34).[69]

Accenture's research is a valuable contribution to the circular economy field, yet it underscores a need for the application of this model in new contexts. My study translates similar themes to the global industry for textiles and outdoor apparel. Apparel is unique from electronics

[66] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[67] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[68] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[69] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.

because clothing garments are produced with materials and supply-chains that look much different than those in electronics. With apparel, there are many more entities at each stage in the value chain: more connections, more actors, which requires more collaboration and involvement between industry partners to effectively make change. There are not as many supply chain actors found in technology, so the circular economy system may be more straightforward in that context. Apparel is an intricate, multi-tiered, global system that can be disorderly at times. When thinking about the prospect of transforming the industry to a CE model, it will be a complicated effort since communication channels are complex and don't allow an entity to easily contact all the supply-chain actors uniformly, or at once. These differences highlight the need to address apparel in its own unique context.

The Ideal Circular System for Textiles and Apparel

Conceptualizing a Circular Economy in Textiles & Apparel

Circularity in Apparel

Circular systems of production and consumption are quite opposite of how the apparel economy currently operates. Less than 1% of clothing is re-integrated into new clothes; instead, volumes of clothing waste are going into landfills or incinerators at the rate of one truckload every second.[70] To employ a circular economy model in apparel would be to entirely reinvent the industry. Yet, the means of achieving this reinvention are quite simple: we can use sharing, swapping, rental, repair, and resale to keep clothes in use for longer; we can choose regenerative, safe materials that don't release toxins into the environment; and we can design clothes for reuse, recycling, and re-integration into new products.[71]

Considering the contradictions that circularity poses to current fashion production, the challenge faced by apparel companies is quite large. However, apparel circularity is conducive to efficiency: "once a raw material is extracted, refined and produced with the usual costs, it makes economic and business sense to use the value produced as long as possible" (39).[72]

Elements of a Circular Apparel System

One of the driving motivations of this research was to conceptualize what an ideal circular apparel system would look like, including the critical stages and key players. There are three areas of circular economy strategy: design, life-extension, and recovery. Below I have outlined thirteen steps across the three stages for industry stakeholders to integrate. Each is a

[70] "Redesigning the future of fashion." *Fashion*, Ellen MacArthur Foundation, n.d.
[71] "Redesigning the future of fashion." *Fashion*, Ellen MacArthur Foundation, n.d.
[72] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

building block of sorts, and together they constitute what a functioning system for circular apparel products would be. Of these thirteen key stages, some are familiar practices already in place, while others completely reimagine processes and partnerships within the value chain.

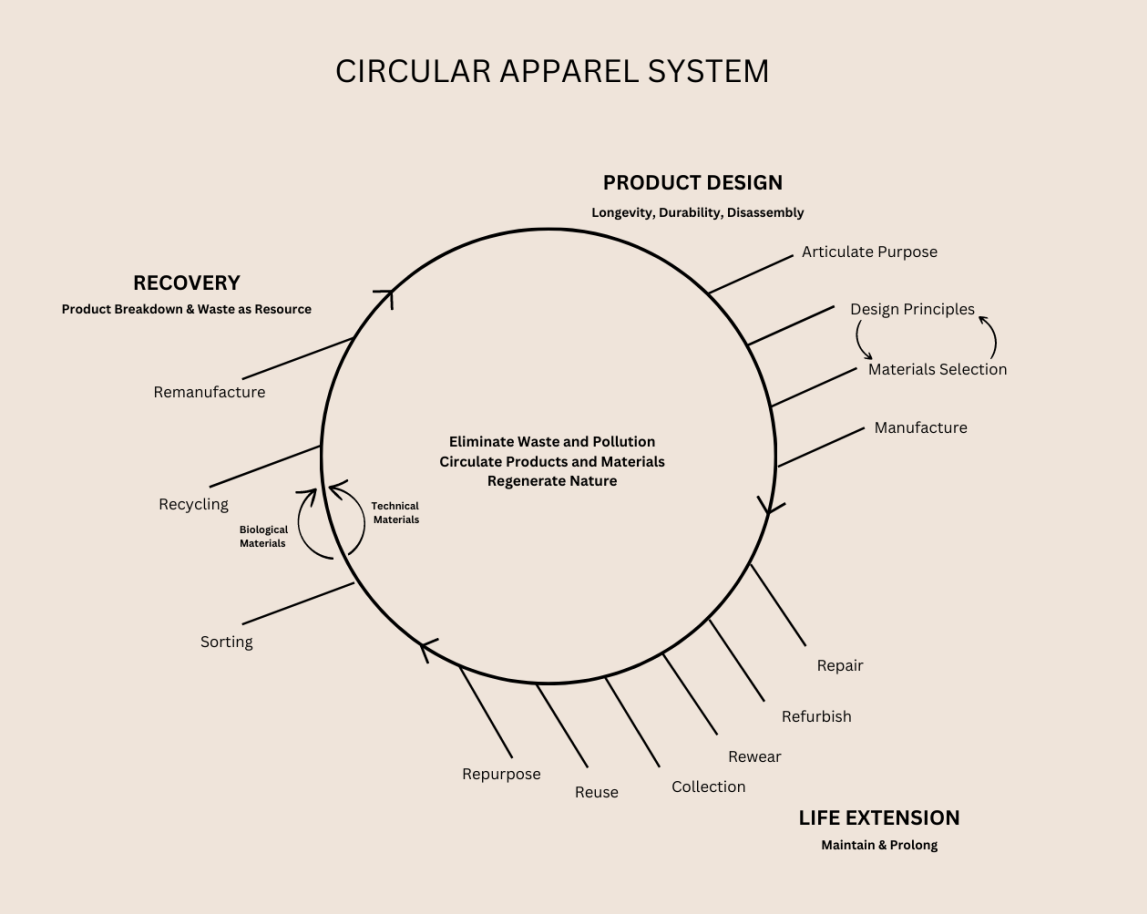

Figure #1: Thirteen Stages of Circular Strategy

Product Design

Establish Purpose: The first step in employing circular practices is setting intentions and aligning business models accordingly. In a circular economy, the newfound purpose of business is "generating profits from the flow of materials and products over time" (308).[73] As a

[73] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018

predecessor to establishing metrics or strategies, guiding principles should be articulated to inform and guide all decision-making in the subsequent steps (67, 80).[74]

Design Principles: Product design is a "signal of intention" (70).[75] Circular garments should follow a method of product design that is slow, closed, and narrow. Slow design emphasizes product longevity by emphasizing qualities such as durability, reliability, repairability, upgradability, and adaptability (310).[76] Closed design aims for all materials to be looped back in through recycling, so it stresses aspects like easy dis- and reassembly as well as nutrient cycle separation Narrow design aims to reduce the number of inputs by using fewer, cleaner resources (311).[77]

Materials Selection: Once an apparel company begins to conceptualize the product, precise decisions are made about the material resources needed for a product to come into being. The most "important single factor which affects the environment is the choice of textile raw materials and non-polluting processing at every step" (70).[78] circular economy aims for materials that are conducive to slow, closed, and narrow consumption with long lasting products. It also requires a differentiation of materials and products in the biological cycle – such as cotton, hemp, or wool – and those in the technological cycle – like nylon or polyester. To reduce environmental impact, "instead of filtering out toxins at the end of the process, try eliminating them from the beginning (72).[79] With materials selection, a company can choose to have a more positive impact that could look like "clean water coming out of factories, paperwork on chemicals was no longer required, employees didn't need protective gear, storage space for

[74] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[75] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[76] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018
[77] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018
[78] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[79] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.

chemicals now free space, fabric trimmings used to nurture the local garden soil" (72).[80] Putting this all together, we can begin to envision garments that are resource efficient, non-toxic, made from recovered or post-consumer recycled materials, and made to withstand the test of time…and trends, for that matter.

Manufacture: This stage encompasses all steps taken to assemble and create a garment. It covers dyeing and sewing fabrics, attaching components like zippers and buttons, and more. This happens in a multi-step process in the apparel value chain where different actors specialize in different functions. In a circular system, manufacturing uses as many closed loop and renewable resources as possible. This would look like anything from using renewable energy to power facilities to using recycling water in the product finishing process.[81]

Life Extension

Repair: Services such as tailoring, sewing, and patchwork can be used to repair any damage or wear that affects the functionality or aesthetic of a garment. These elements of product upkeep are fundamental to extending the lifetime of clothing. According to product condition and the repair needed, this can be performed by individual consumers or taken into a business with repair services.

Refurbish: If a garment is aging but not damaged, refurbishment can help freshen up garments that are still functioning. Upgrading or customizing can help increase aesthetics through embroidery, dyeing, printing, or similar crafts to make a garment feel like-new (32).[82]

[80] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[81] "The Technical Cycle of the Butterfly Diagram" Circular Economy, Ellen MacArthur Foundation, n.d.
[82] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.

Re-wear: This stage is realized through personal efforts to keep garments already in our closets in use. Instead of over consumption and opting to purchase new, consumers should first turn to clothes they already own or have in close reach. This can manifest in a number of ways, but some common examples would be using unofficial channels like borrowing and sharing, renting out personal items, or even hosting community clothing swaps. The re-wearing stage is an accessible method of reusing garments before they go back to official channels run by apparel companies (77).[83]

Collection: After personal efforts to keep garments in use have been expended, clothing should be looped back into the economy through collection networks. In addition to apparel brands and retailers, cities and other entities in waste management can facilitate the take-back of garments to avoid consumers throwing them in the garbage (76).[84] Specific elements of collection networks for apparel can be found in later sections. Depending on garment condition, the collection stage helps to reroute garments to either reuse, repurpose, or sorting.

Reuse: Reuse is what happens when a garment leaves the hands of its original owner and reaches a new consumer, relying on resale channels to redistribute products. The garment gains an additional lifecycle that would not occur if it was disposed of directly after the first consumer. Resale, rental, and reverse logistics are primary business services needed at this stage. Maintenance services like repair and refurbish have an important role to play to uphold the ability of garments to go through the reuse stage. Reuse is a "hidden giant in terms of positive economic impact by saving raw materials and energy used in manufacturing plants" (71).[85]

[83] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[84] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[85] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.

Repurpose: This stage aims to turn fabrics from unwearable products into new items. It is a type of primary recycling in which value is retained by preserving the composition of existing materials but turning them into something of a different form. One example of this would be repurposing a pair of denim jeans into bags, bucket hats, or other patchwork products.[86]

Recovery

Sorting: After garments have been collected, those in poor condition are ideally bound for recycling. To enable effective recycling, goods must be differentiated by material type. Later in this study, the importance of separating material composition to the biological and technical nutrient spheres will be underscored.

Recycling: Recycling is a process used to recover the embodied materials, resources, and energy of garments that are no longer usable for other applications. The purpose is to avoid materials from reaching the landfill, where any value they may still possess is immediately lost. There are many levels and ways in which textile recycling occurs which are further discussed in the coming sections of this study.

Remanufacture: This stage loops recycled or recovered materials, fabrics, and parts back into the manufacturing of "new" goods. The term "new" is not used to imply goods with virgin resource inputs, but rather to explain that manufacturing additional garments can occur with the use of recovered materials. Remanufacturing highlights the importance of design to create adaptive products that can be disassembled and reassembled using secondary materials.

[86] "Circular Economy Introduction." Ellen MacArthur Foundation, n.d.

Actors and Key Players

Actors in Apparel

In the apparel industry, the structure of supply chains has grown to be extremely complex and multi-tiered. The figure below maps out key actors that exist within apparel value chains at different points in garment production, from raw materials suppliers to knitters, dyers, assemblers, trading companies, brands, and more. When considering other consumer goods industries like technology, comparatively, apparel has many more supply chain actors that go into making one product. In addition to the volume of actors, these supply networks are often operating globally, crossing international borders at different stages. Due to the far-flung nature of apparel supply chains, stakeholder groups like consumers and investors are often far removed from the social and environmental impacts of production; the burdens occur out of sight, diluted across a range of production locations that commonly appear in developing economies.

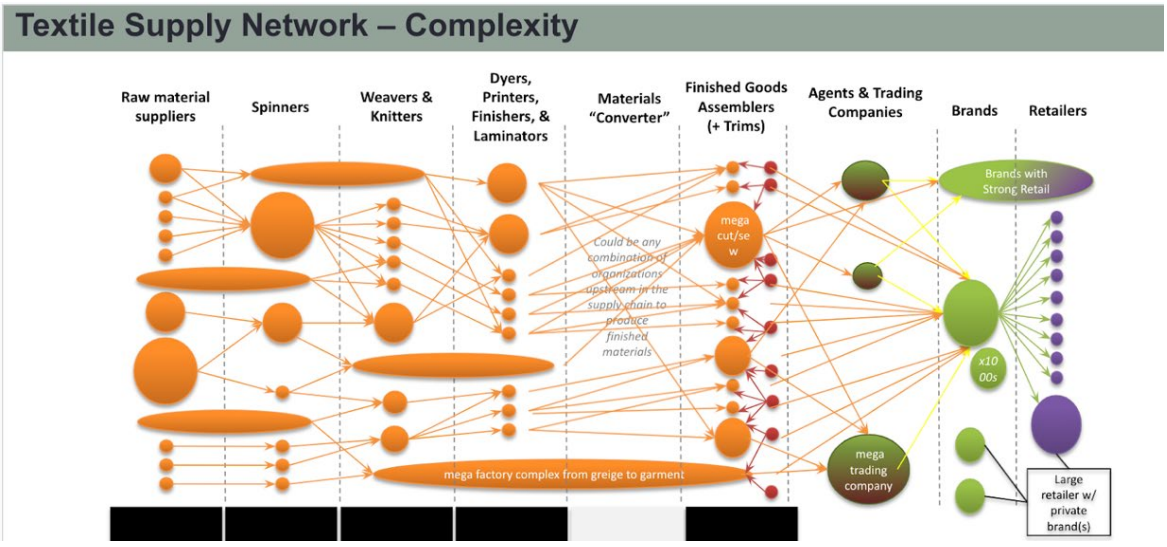

Figure #2: Textile Supply Network Complexity [87]

[87] Diagram created by Jeff Wilson and Matt Thurston, REI

Key Players in Circularity

It is important to call attention to one key stage not included in my diagram: implementation. How do we implement a circular system? Who does what in the implementation process, and who must act first? With the complexities of the apparel industry in its current form, implementation is "the nut everyone is trying to crack,"[88] For each key step, there are key actors that must be involved to implement, collaborate, and participate in key processes that keep the circular economy in motion.

In product design, stages 1-4, brands and retailers face the primary responsibility of getting the wheels turning. The end-of-life outcome of a product often results from its design: the intended use and lifecycle of a good influences where it ends up post-use. Brands and retailers must implement principles of circularity into their designs, but they also need a market for circular goods to engage in this; there must be consumer demand. Suppliers are an equally important figure. As brands are compelled to adhere to increasingly green standards, their suppliers must comply with those regulations and collaborate towards the goal of making key materials – such as those with recycled content – available.

The life-extension efforts that occur in stages 5-10 heavily fall on the consumer to take initiative in prolonging and upkeeping their garments through repairing, sharing, and selling. Brands must also make such maintenance services available and easily accessible. Companies can even incentivize participation through mail-in repair or giving out credit for unwanted items. There is a significant and growing opportunity for third parties to operate in the life-extension stage, providing services to facilitate reverse logistics and operations for brands as they take on

[88] J. Taylor Sloan (personal communication), 2 Feb 2023.

new repair, rental, and resale initiatives. Or third-party companies can come in as life-extension businesses on their own, such as second-hand markets like eBay.

The recovery of products and materials, stages 11-13, requires the cooperation and collaboration of all actors in the textile networks: the brand, retailer, and all key supply-chain partners (suppliers, spinners, finishers, assemblers), and even consumers. Customers must provide a supply of their pre-owned garments and create a demand for purchasing recycled goods that will translate into more profitable markets for secondary materials. Brands and retailers collect, process, and sort the products and materials, acting as the middlemen between consumers and the supply chain. Supply chain partners including recyclers, suppliers, spinners, finishers, and assemblers are of the utmost importance in the recovery stages. Brands are often not doing the material reprocessing themselves, so it is these supply chain actors that work with the materials and, in doing so, they must comply with standards set by their brand partners. This can be particularly challenging since apparel companies generally lack visibility into their multi-tiered supply chains, meaning they are only in contact with one supplier in an entire network of actors they need to collaborate with.

Case Companies: Brand Overview

Patagonia

Founded in 1973, this California-based brand produces some of the most iconic outdoor gear and apparel garments to date.[89] A privately owned enterprise of about 3,000 corporate employees, Patagonia operates offices and retail stores globally, bringing in an annual revenue of

[89] "Company Profile: Patagonia, Inc." *Gale Business Insights,* State of Oregon Library, n.d.

about $1B.[90] The brand has disclosed that its supply chain – consisting of about 75 factories and 100,000 workers – accounts for 97% of the company's carbon footprint, with a substantial 86% coming from raw materials alone.[91]

Patagonia has proved to be a progressive brand since its inception, and that has not changed in recent years. Patagonia is known to be somewhat of an environmental activist in apparel and has been rather vocal about the circular economy as a model worth pursuing. As of late 2022, the company's founder even decided to switch Patagonia's ownership with a lack of "faith that the company's values could survive the short-term pressures of the stock market."[92] Moving forward, 2% of the company will be left in the hands of the Patagonia Purpose Trust to maintain the company's integrity, while 98% of ownership is given over to the Holdfast Collective. The Holdfast Collective is a new 501(c) (4) entity, "dedicated to fighting the climate crisis and protecting natural resources."[93] The corporation itself will function entirely the same, with the only difference being that its' profits are redirected toward environmental organizations and climate action.

REI Co-Op

Recreational Equipment Inc. (REI) was established by a group of climbers in 1938 as a member-owned cooperative.[94] As a co-op that boasts over 23 million members, the company "invests more than 70 percent of its annual profits back into the outdoor community through

[90] "Best in Business: Meet the 241 companies we admire most, for the power they put into purpose and the positive impact they have on this world" *Gale Business*, Mansueto Ventures LLC, vol. 44, no. 6, 2022
[91] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021, https://www.patagonia.com/stories/our-quest-for-circularity/story-96496.html
[92] "Best in Business: Meet the 241 companies we admire most, for the power they put into purpose and the positive impact they have on this world" *Gale Business*, Mansueto Ventures LLC, vol. 44, no. 6, 2022
[93] "Best in Business: Meet the 241 companies we admire most, for the power they put into purpose and the positive impact they have on this world" *Gale Business*, Mansueto Ventures LLC, vol. 44, no. 6, 2022
[94] "Who We Are." *Shop REI*, REI Co-Op, n.d., https://www.rei.com/about-rei

dividends to its members, employee profit-sharing and retirement, and investments in nonprofits dedicated to the outdoors."[95] Functioning simultaneously as an outdoor gear brand and a retailer for other brands, the company is well-established in the United States, with around 16,000 employees and 181 retail stores.[96] In 2021, REI brought in $3.7B in revenue.[97]

Cotopaxi

Cotopaxi is an outdoor gear and apparel brand, based in Salt Lake City, Utah with around 300 current employees.[98] This private company was established in 2014 as a public benefit corporation, backed by 28 investors in venture capital.[99] The company is quite young compared to Patagonia and REI, approaching its ten-year mark in 2024. Cotopaxi has secured certified B-Corp status for eight of the ten years, locking in a vision for sustainability into its business model.[100] In its foundation, Cotopaxi's business model was intended to align with its mission to "inspire social and environmental change as a means to improve the human condition, increase social consciousness, and alleviate poverty."[101] The company is driven by a passion to provide customers with sustainable options for gear and apparel that can be utilized in outdoor exploration. And the brand can be easily recognized by vibrant, eye-catching products that don't shy away from color.

[95] "Company Profile: Recreational Equipment Inc." *Gale Business Insights*, State Library of Oregon, n.d.
[96] "Who We Are." *Shop REI*, REI Co-Op, n.d., https://www.rei.com/about-rei
[97] "Company Profile: Recreational Equipment Inc." *Gale Business Insights*, State Library of Oregon, n.d.
[98] PitchBook. "Cotopaxi Overview" *PitchBook*, n.d., https://pitchbook.com/profiles/company/64553-05#overview
[99] "2022 Impact Report." *Cotopaxi*, March 2023.
[100] Maahs, Caroline. "8 Years of Being a B Corp." *Cotopaxi*, n.d.
[101] Maahs, Caroline. "8 Years of Being a B Corp." *Cotopaxi*, n.d.

Circularity Data & Reporting

Overview

The landscape for sustainability data and reporting is quickly evolving. As a tailored approach to sustainability, it is critical to consider what metrics and tools are necessary to effectively monitor and report progress on circularity. A notable setback of the apparel industry at large is the lack of regulation that exists around sustainability reporting in general. There is no set industry standard, however, frameworks like CDP are becoming increasingly prevalent tools used by companies to report on their environmental impact.

Today, companies are not required to report on sustainability performance, yet many of them do in response to investor demand and the PR risks posed by not addressing their impacts. With no mandated or standardized process, voluntary self-reporting can lend itself to inconsistent goals, methods, data metrics, and reporting frameworks across industries like apparel.[102] Not only does this make it extremely hard to benchmark companies, but it can be difficult to ensure the reliability of information companies provide as they aim for greater transparency. Additionally, reporting becomes increasingly complicated in industries like apparel, who frequently lack transparency into their supply chain but need the compliance of a set of supply-chain actors.

One of the biggest challenges that exists for apparel today is measuring sustainability performance and being able to scale those measurements on a product level basis.[103] Figuring out how to "make product level data reliable, dependable, and accessible to consumers" is an

[102] Kotsantonis, Sakis and Serafeim, George. "Four Things No One Will Tell You About ESG Data." *Journal of Applied Corporate Finance*, vol. 31, no. 2, 2019

[103] Larson, Guru. "Panel 1: Sustainability Challenges & Opportunities." Summit for Sustainable Organizations (SSO), University of Oregon MBA, 14 Apr. 2023, Lillis Business Complex, Eugene, OR. Conference.

essential step to build integrity in an industry that has lacked transparency for so long.[104] One of the tools to collect product level data on environmental impact is a Life-cycle Assessment. However, these studies can take substantial time and money to complete per garment, multiplying total costs for a wide range of product offerings. The Sustainable Apparel Coalitions' Higg Index has established common metrics for materials sustainability; yet the challenge to collect reliable data per garment and robustly implement mechanisms for impact monitoring persists.[105]

In recent news, the Securities and Exchange Commission released a proposal that would require publicly traded companies to report on their Scope 3 carbon emissions.[106] If this proposal gets passed, it will be a monumental step for the industry. Yet one key problem remains: comprehensive sustainability reporting frameworks cover many grounds, and they don't provide guidance to help businesses weigh the trade-offs that may exist.[107] Increasing regulation poses a unique opportunity for industry-wide and economy-wide discourses around how to benefit from sustainability pursuits and turn tradeoffs into incentives.[108]

Circulytics

Circulytics is a measuring tool created by the Ellen MacArthur Foundation to evaluate "the extent to which a company has achieved circularity across its entire operations."[109] The purpose of Circulytics is to provide companies with a means of measuring performance to guide decision making, increase transparency, highlight strengths, blind spots, and opportunities, as

[104] Larson, Guru. "Panel 1: Sustainability Challenges & Opportunities." 14 Apr. 2023.
[105] Larson, Guru. "Panel 1: Sustainability Challenges & Opportunities." 14 Apr. 2023.
[106] "SEC Proposes Rules to Enhance and Standardize Climate-Related Disclosures for Investors." U.S. Securities and Exchange Commision, 21 Mar. 2022, https://www.sec.gov/news/press-release/2022-46
[107] McCusker, Erin. "Panel 1: Sustainability Challenges & Opportunities." Summit for Sustainable Organizations (SSO), University of Oregon MBA, 14 Apr. 2023, Lillis Business Complex, Eugene, OR. Conference.
[108] McCusker, Erin. "Panel 1: Sustainability Challenges & Opportunities." 14 Apr. 2023.
[109] "Measure Business Circularity: Circulytics." *Circulytics*, Ellen MacArthur Foundation, n.d.

well as make impactful progress toward a circular economy. The framework is applicable to all companies, regardless of industry or size. Yet, the weight allocation for scoring may differ, heavily depending on the industry of a given company. Right now, Trove is one of few companies relevant to the apparel industry that is signed up for Circulytics; none of the case companies featured in this thesis appear, however we do see other fast fashion brands like H&M engaging with the framework.[110]

The Circulytics method uses a total of 37 indicators across 11 themes to score companies from A to E based on how conducive their operations are to supporting a circular economy.[111] All the indicators fall into one of two categories: "enablers," the aspects required for organizational change, or "outcomes," the actual circularity performance of a company. Themes in the enablers category and their respective score weight include [1] strategy and planning (30%), [2] innovation (20%), [3] external management (20%), [4] people and skills (15%), and [5] operations (15%).[112] In the outcomes category, companies are being scored on themes of [6] products and materials, [7] services, [8] plant, property, and equipment assets, [9] water, [10] energy, and [11] finance.[113] As previously mentioned, the weight given to "outcome" performance scores may vary by industry. A production-intensive industry like apparel will give more weight to the material flows and services score, and less weight to finance. A service-oriented company will give more weight to asset and energy scores, with less weight going to material flows (13).[114]

[110] "Measure Business Circularity: Circulytics." *Circulytics*, Ellen MacArthur Foundation, n.d.
[111] "Circulytics - Brochure - 22 ENG." *Circulytics*, Ellen MacArthur Foundation, 2022.
[112] "Method Introduction." *Circulytics*, Ellen MacArthur Foundation, 2022.
[113] "Method Introduction." *Circulytics*, Ellen MacArthur Foundation, 2022.
[114] "Method Introduction." *Circulytics*, Ellen MacArthur Foundation, 2022.

Product Materials Selection

Nutrient Cycles

All materials can be characterized as either biological nutrients or technical nutrients. The following sections aim to evaluate efforts from the four case study companies to create two fully circular garments, one in each nutrient sphere.

Biological Materials

Biological materials are organic, meaning they come from natural environments and processes. They are consumable, biodegradable, compostable, and restored to the Earth at the end of their lifecycle by natural processes.[115] Take food, for example: a banana tree uses nutrients in the soil, water, and sunshine to grow and produce its fruit. That fruit is consumed by other living organisms; and the peel or "waste" is composed. Anaerobic digestion by bacteria in soils breaks down the peel, using it as food for themselves. Like a banana peel, all biological nutrients can re-enter natural systems that utilize them to grow something new, or power a different cycle and "rebuild natural capital."[116] Even more literal forms of waste, such as animal excrement, contains nutrients used by microbes and fungi, which create the soil conditions necessary for plant growth, which provides food for animals, and so on. The biosphere remains functioning by these cyclical processes (14).[117]

There are three key processes to keep biological materials in circulation. The first is to reuse materials by finding all additional applications, even looking for different value streams

[115] "The Biological Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[116] "The Butterfly Diagram: Visualizing the Circular Economy." Circular Economy, Ellen MacArthur Foundation, n.d.
[117] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.

outside of the materials' intended use (42).[118] Then, biorefineries can extract feedstock that becomes anaerobically digested, biogas, or other biochemical feed.[119] The last and most fundamental process for biomaterials is regeneration: the composting of materials that lack any further extractive value.[120]

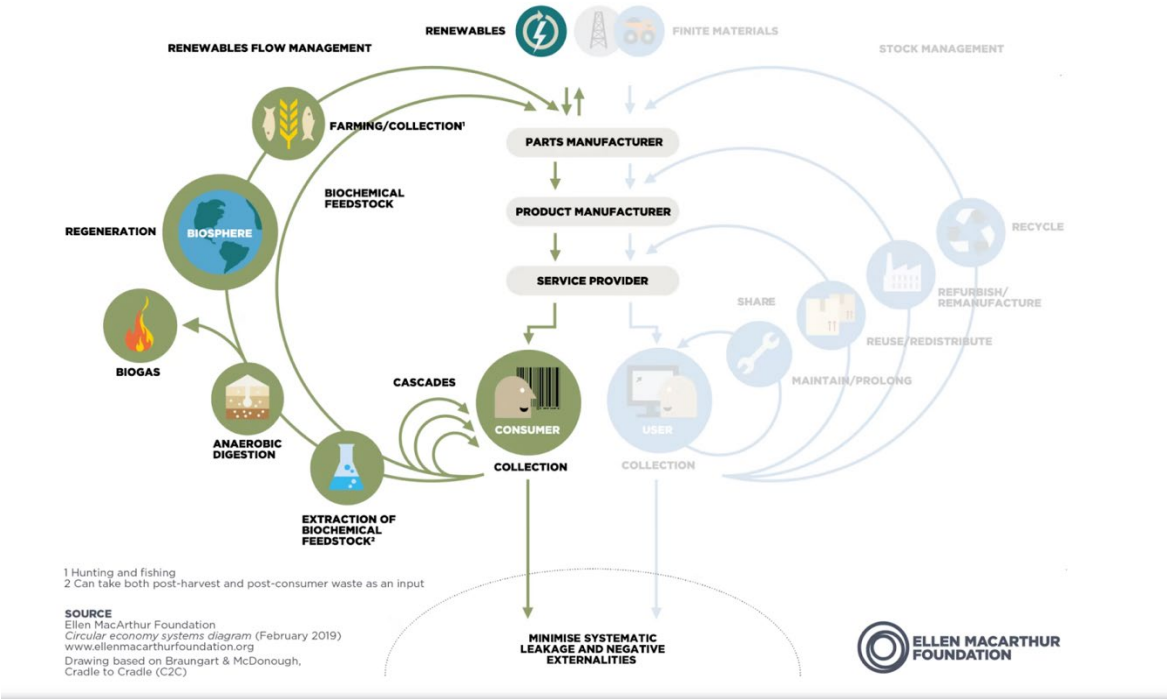

Figure #3: Circularity in the Biosphere [121]

Technical Materials

Materials in the technical sphere are made up of non-biodegradable matter, such as metals and plastics. These are not consumed by living organisms since they are not naturally occurring in the biosphere, but rather are continuously utilized (14).[122] When it comes to

[118] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[119] "The Biological Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[120] "The Biological Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[121] "The Biological Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[122] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.

materials on this side, the biggest issue is resource management and keeping materials in circulation for as long as possible.

To avoid nutrients in this cycle becoming waste products, there are four key strategies that can be used to manage technical materials.[123] It starts with maintaining the materials and prolonging their use in their original application for as long as possible. The next path is for technical materials to be captured in takeback systems and redistributed for use in other applications. For example, a privately owned vehicle can be utilized on car sharing platforms or resold in a used-car market. These primary steps "are where most value can be captured because they retain more of the embedded value of a product by keeping it whole."[124] Refurbishing and remanufacturing are the subsequent pathways for technical materials to follow, whereby existing materials can be repaired and factored into a new item. Only after materials have no further value for use or extraction, recycling is the last strategy to minimize technical waste.[125] Unlike the ease of recycling in the biological sphere, which happens naturally by composting, recycling in the technical sphere can be extremely difficult due to the inorganic, complex nature of the materials.

The epitome of circular strategies for technical materials is highlighted in the case of electronics. For example, considering a smartphone: "a working phone is worth more than the sum of its parts because the time and energy that went into making it is not lost. Therefore, inner loops like sharing, maintaining, and reusing should be prioritized above the outer loops that see the product broken down and remade."[126] The Accenture study on circular electronics, discussed in previous sections, ties in nicely with technical apparel products because they both involve

[123] "The Technical Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[124] "The Technical Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[125] "The Technical Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[126] "The Technical Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.

difficult-to-recycle materials, so there are robust strategies that can be employed before recycling.

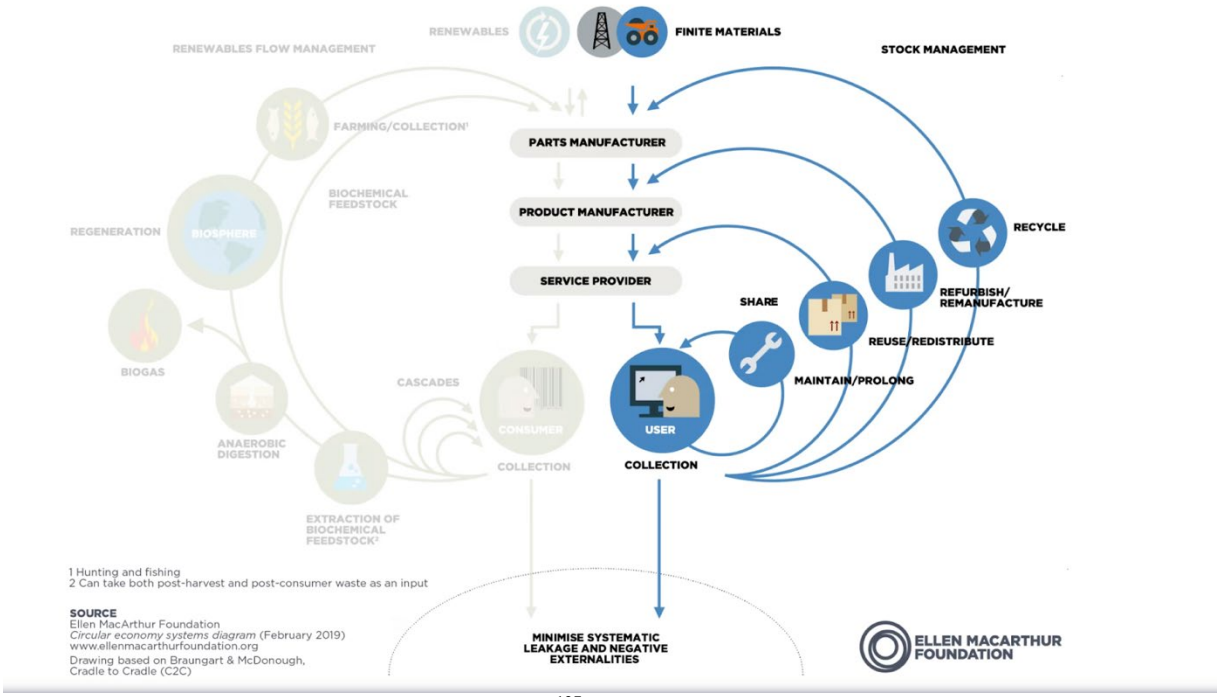

Figure #4: Circularity in the Technosphere[127]

Cross-Contamination

When these two categories of materials – biological and technical – remain in their separate spheres, in theory they can remain infinitely looping through these strategies. However, when they are not differentiated and instead mixed into a combination of both material types – like a juice box that contains both cardboard and aluminum – the cross-contamination of nutrients makes them difficult to separate, and thus difficult to recycle (14).[128]

In products made of mixed materials, much of the value is lost after initial efforts to maintain, prolong, and reuse, because there are no pathways for those products to be properly

[127] "The Technical Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[128] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.

broken down (14).[129] This is the case of most products in the apparel industry; one of the most common everyday-wear garments is a cotton-polyester blend t-shirt. Garments like these contain a conglomerate of fabrics coming from both nutrient cycles, and the industry is thus experiencing huge value losses due to an inability to separate and reuse those materials.

Another pivotal consideration is the type of energy used to power strategies for prolonging, reusing, and recovering materials. Everything in the technical process must be powered by renewable energy because it exists outside of natural processes.[130] On the biological side, however, using renewable energy is not of as much concern because those processes happen naturally, powered by things like solar energy.

Company Case Studies: Materials Strategy

Patagonia's Approach to Materials

Patagonia's products all go through an informal quality checklist in the design phase. Based on this checklist, their design philosophy outlines the meaning of a "quality" based on the following attributes: functional, multifunctional, durable, causes no unnecessary harm, repairable, aesthetic appeal, well-fitting, easy to care for, globally relevant, simple.[131]

The company has a materials innovation and development department that consists of thirty employees. The primary objective of this department is to evaluate the environmental impact of its goods, using product level metrics such as the carbon intensity or amount of preferred materials in a singular garment.[132] Patagonia has not shied away from collaborating with other apparel entities, as the company is guided by tools and knowledge from the

[129] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[130] "The Technical Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.
[131] "Quality Is an Environmental Issue." *Patagonia Stories*, Patagonia, n.d.
[132] "Quality Is an Environmental Issue." *Patagonia Stories*, Patagonia, n.d.

Sustainable Apparel Coalition (SAC). In fact, Patagonia has found the SAC's Higg Index especially useful for measuring and assessing the lifecycle impacts of its products.[133]

Patagonia's progress towards circularity began in 2005, well before most of the industry was discussing the circular economy concept.[134] Featured in Table #1, Patagonia's Tee-Cycle is one garment that it seeks to achieve full circularity with but has not been entirely successful. The company recognizes that t-shirts made from post-consumer, recycled cotton provide the best opportunity to focus current circularity efforts due to the availability of discarded t-shirt stock and recyclability of cotton – a biological material. Because circularity cannot be achieved by one brand alone, the company partners with Vertical Knits, a manufacturer based in Mexico, and the Finland-based recycler, Infinite Fiber, to help facilitate their Tee-cycle production.[135]

REI's Approach to Materials

REI is guided by a set of product impact standards which outline key environmental and social categories that the company attempts to address in its material selection process.[136] The most prominent impact categories are chemicals management, animal welfare, climate stewardship, diversity and inclusion, and safe supply chains. Specific qualities and certifications are sought after and even included as key drivers of REI's material selection strategy. Fair Trade Certification is one such example, and some others include USDA organic, climate neutral certified, or Bluesign® approved. By 2030, REI aims to have 100% of its product selection to have at least one of these preferred attributes. The company still has plenty of work to do, as only

[133] "Quality Is an Environmental Issue." *Patagonia Stories*, Patagonia, n.d.
[134] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.
[135] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.
[136] "Product Impact and Re/Supply." *REI Stewardship*, REI Co-Op, n.d.

24% of sales in FY2021 included products with a "preferred attribute" or degree of sustainability.[137]

Materials selection is one of the places REI is most transparent about its sustainability efforts and progress. To drive decision-making around impact, REI utilizes a tool created by the Sustainable Apparel Coalition's Higg Index.[138] The Higg Index helps REI, like many other apparel companies, monitor and assess critical data points related to the environmental impacts of its value chain. Tools like these are of utmost importance to understand the impact of sourcing; and REI has translated this knowledge into a strategy to prioritize and deprioritize certain materials. The company is seeking to integrate more organic cotton, certified down, certified wool, lyocell, and recycled materials into its products, while avoiding inputs like alpaca wool, bamboo rayon, and PVC.[139]

To further implement impact-driven decision making, REI also evaluates the health of its supply chain inputs before manufacturing.[140] The brand discloses its restricted substances list, aligned with standards set by the Bluesign® certification. Notably, the brand is on a path to eliminate durable water repellent (DWR) treatments from all REI co-op brand products because it contains PFAs, a type of hazardous chemical commonly used for making products waterproof. With all the outdoor apparel REI makes, the company has admitted that it still uses PFA-based treatments "where viable alternatives do not yet exist."[141]

REI's endeavors to improve the sustainability, or circularity, of materials provides a few valuable insights. Certifications and eco-labels are an effective way to adhere to product impact

[137] "Product Impact and Re/Supply." *REI Stewardship*, REI Co-Op, n.d.
[138] "Product Impact and Re/Supply." *REI Stewardship*, REI Co-Op, n.d.
[139] "Product Impact and Re/Supply." *REI Stewardship*, REI Co-Op, n.d.
[140] "Product Impact and Re/Supply." *REI Stewardship*, REI Co-Op, n.d.
[141] "Product Impact and Re/Supply." *REI Stewardship*, REI Co-Op, n.d.

standards while providing stakeholders with reliable product information. Additionally, systems for tracking and interpreting impact related data are a powerful tool that can help assist decision making in a manner that is sustainably minded. And lastly, there are challenges with technical outdoor garments because of the special treatments or materials they require to establish desired, performance-level qualities.

Cotopaxi's Approach to Materials

Cotopaxi follows an internal framework called the "3R's" which aims to incorporate repurposed, recycled, or responsibly sourced materials into every garment (34).[142] Already, 97% of the brands' entire product selection incorporates materials with at least one of the "3R" qualities; Cotopaxi hopes to reach 100% by 2025. Not to mention, collections like the (Re)Purpose line uses "fabric left over from other companies production runs" and Cotopaxi is capitalizing on the marketing opportunity to brand such products as limited-edition and one-of-a-kind.[143]

Like the previous two companies, Cotopaxi is also finding it hard to implement low impact materials without having trade-offs in desirable traits like durability or longevity. Certain product lines are giving the brand a harder time than others, yet, despite this, Cotopaxi is going forward with the materials transitions anyways to prioritize sustainability above all else.[144]

This brand is a great model when it comes to sourcing transparency. Cotopaxi discloses what suppliers they work with – who the actors are, where they operate, what standards they have in place, and how they audit partner facilities (42).[145] The company also provides

[142] "2022 Impact Report." *Cotopaxi*, March 2023.
[143] "Sustainable by Design." *Cotopaxi*, n.d., https://www.cotopaxi.com/pages/sustainable-by-design
[144] "2022 Impact Report." *Cotopaxi*, March 2023.
[145] "2022 Impact Report." *Cotopaxi*, March 2023.

definitions for all terms where it may be unclear or ambiguous. For example, a "responsible" material is defined as that with a third-party certification, like Fair Trade certified.[146]

As a newer brand, Cotopaxi does not have to face challenges posed by switching already existing products; rather, the company finds opportunities to create responsible products – like sourcing deadstock fabrics – and starts there. Cotopaxi's strategies around materials highlights the importance of responsible sourcing practices and transparency. The brand has built an identity around its positive impact, using elements of storytelling to demonstrate that the company's mission resides behind every decision and every product.

Biological-Based Garments

Efforts to create a fully circular cotton t-shirt, a garment in the biological nutrient sphere have not yet been successfully achieved. Table #1 below features one garment from each company featured in this study. There are clear variations among the material composition, eco-certifications, price points, and marketing of these garments.

Company	Patagonia	REI	Cotopaxi
Item name	Men's Tee Cycle	Logo T-shirt	Organic T-shirt Men's
Materials	-70% pre-consumer recycled cotton -30% Infinna post-consumer recycled cotton	-50% organic cotton -50% recycled polyester	-60% organic cotton -40% recycled polyester
Certifications	-Fair Trade certified sewn	-Bluesign® approved polyester	-Fair Trade certified
Factory Location	-Mexico	-USA	-India
Other	-PVC and phthalate free inks		

[146] "Sustainable by Design." *Cotopaxi*, n.d.

Retail Price	$49	$29.95	$35
Product Sustainability claims	"This tee celebrates our commitment to creating a circular economy, so it's made of discarded tees destined for the landfill and helps solve the textile waste problem" "Can be recycled into a new T-shirt at the end of its useful life; this t-shirt is part of our goal to create a closed-loop process for clothing" "Helps reduce textile industry waste and lower carbon emissions compared to using virgin cotton"	"Made to reflect our love for people and the planet through the use of organically grown cotton and bluesign-approved polyester" "Organic cotton typically has a lower environmental impact than conventionally farmed cotton" "Bluesign materials conserve resources and protect the health of the environment, workers, and wearers (you!)" "Using recycled materials helps keep waste out of landfills"	"Everything is going to be just fine. At least that's the positive energy we want to channel when we throw on this super soft tee." "Sustainably minded- The t-shirt is made with organic cotton and recycled polyester" "This factory follows stringent social and environmental standards that contribute to worker safety, well-being, and income sustainability"

Table #1: Benchmarking Biological Garments

Synthetic-Based Garments

Table #2 below highlights what each case study company has done aiming to create a sustainable garment in the technical nutrient sphere, in the form of a women's rain jacket. Technical materials have different considerations than biological ones, often posing more challenges regarding toxicity and recyclability. The table below includes material composition, eco-certification, price, and related information pertaining to the technical product offerings.

Company	Patagonia	REI	Cotopaxi
Item name	Women's Torrentshell 3L Jacket	XeroDry GTC Jacket - Women's	Cielo Rain Jacket - Women's
Materials	-Face: 100% ECONYL recycled nylon	-Polyester	-100% recycled polyester

	-Membrane: polycarbonate PU, 13% biobased content		
Certifications	-Fair Trade certified sewn	-Fair Trade certified sewn -Bluesign® approved	
Factory Location	-Vietnam		-China
Other	- PEC-free DWR coating finish - Supplier is Toray International, Inc. based in Osaka, Japan	-DWR finish -GORE-TEX PACLITE® technology	-PFC-free DWR -Supplier is Unicorn Recreation Products Co., LTD based in China
Retail price	$179	$169	$145
Product Sustainability Claims	"Simple and unpretentious, our trusted Torrentshell 3L Jacket uses 3-layer H2No® Performance Standard technology and a PFC-free DWR finish (durable water repellent coating that does not contain perfluorinated chemicals) for exceptional waterproof/breathable performance, all-day comfort and long-lasting waterproof durability"		"This PFC-free jacket is made from 100% recycled polyester, giving it a sustainable edge over comparable jackets" "This product is produced at a forward-thinking factory in northeastern China, where worker well-being is a top priority. The factory is also working to meet the highest standards of sustainability and efficiency"

Table #2: Benchmarking Technical Garments

Materials Analysis

There is a widespread struggle to make technical products more circular by design. Materials like polyester and nylon and coatings like DWR have been used to establish a high-quality and long-lasting garment in the technical sphere. However, these often have more significant environmental impacts from things like the hazardous chemical use and non-recyclability associated with synthetics (54).[147] This has, in part, led to the problem of clothing

[147] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.

waste going to landfills and incinerators. With the presence of hazardous chemicals in dyes, pigments, and coating for technical garments, incineration poses serious environmental health concerns. The incineration of biological garments is also troublesome, as those materials usually have value that can be applied elsewhere – "food" for another part of the system – before combustion (40).[148] In both cases, much value is being lost to the fact that neither technical nor biological garments are really returning to the technosphere or biosphere.

One clear implication of the challenges that exist to achieving circularity in both nutrient spheres is the quality or grade of materials. Not all technical materials are durable by nature of being synthetic, and not all biological materials are low impact just because they are looped into natural environmental processes. Across the board, high-quality materials will be more fit for circularity – they will have longer lifespans, and if they circulate for longer, it means we can avoid manufacturing virgin products for longer and reduce the overall amount of raw materials needed.

In many cases, brands in outdoor apparel are having to choose between desirable product traits and sustainability in material sourcing decisions. Where trade-offs do exist, there is a lack of guidance for companies in decision making.[149] Many well-meaning brands are navigating large hurdles between wanting to lower their impacts but retain a similar performance level of their goods. Certifications and eco-labels like Fair Trade™ and Bluesign® are one approach to this challenge, shifting the focus to material quality. They provide a standard that ensures quality and sustainability according to standards that are specific to each corresponding material.

The conversations around apparel sustainability are also vital to the success of circular strategies. We see companies commonly disclosing the location of their suppliers, but a varying

[148] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018
[149] McCusker, Erin. "Panel 1: Sustainability Challenges & Opportunities." 14 Apr. 2023.

amount of information exists around factory details and conditions. Some brands like Cotopaxi and Patagonia provide significant details about the factory name, location, demographics, standards, auditing methods, and more – sometimes even on a product-by-product basis. This needs to be a standardized practice in apparel because transparency helps enforce accountability and is especially impactful in spaces like apparel that do not yet have regulated means of tracking and reporting.

Sustainability related conversations also extend to product marketing. Comparing bio-based garments and technical garments, there are some differences in the tone used by brands to talk about product impact. Notably, the product claims for t-shirts, which contain biomaterials like cotton, focused more on the positive impact and how it helps create value, using softer language such as "reflecting love," "well-being," "useful," and "helps solve the textile waste problem."[150] The technical products, however, have language that emphasizes negating impacts and reducing harm, for example: "does not contain chemicals."[151] It is possible that the differences in marketing are partial to the fact that each nutrient sphere exists independently with its own set of challenges and each product has a lifecycle with emphasis on different loops. However, it may be important to have consistency in the way garments are marketed as they would aim for the same end-goal, circularity.

[150] See Table 1 above.
[151] See Table 2 above.

Clothing Resale Models

The Resale Business

Introduction

Somewhere between 80 to 100 billion garments are produced each year, and clothing is a type of consumer good that we tend to hang onto for a while.[152] Considering this, there is a clear need for the resale of apparel items. Still, today only 20% of textiles are even collected.[153] Resale is one way that circularity manifests; it has become a clearly identified strategy for many brands aiming to tackle their environmental footprint and is taking up a larger share of apparel markets each year. Over 120 apparel brands are currently operating second-hand resale programs (20).[154] Because it is a commonplace strategy in the circularity toolkit, looking into the many ways resale happens can help us understand the business value associated with different models.

Though several big names in apparel already operate resale businesses, it needs to be implemented on a more widespread level in order to achieve a system that more closely resembles circularity. This is because offering a selection of second-hand garments enables brands to "derive revenue from existing products by selling them multiple times instead of making new products that carry the majority of environmental costs" (19).[155] On a systemic level, resale provides an opportunity for significant reductions in environmental impact from the use of raw materials to emissions. In fact, 70-80% of a product's CO2e footprint comes from the process of manufacturing it new (19).[156]

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[152] "Resale Report 2023." thredUp, 2023, https://cf-assets-tup.thredup.com/resale_report/2023/thredUP_2023_Resale_Report_FINAL.pdf
[153] "Resale Report 2023." thredUp, 2023.
[154] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." Trove, OSF Digital, 2023, https://trove.com/brand-resale-index/
[155] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[156] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

There is also an economic benefit to resale, as it provides means to build an additional revenue stream generated by getting another lifecycle out of the same product.[157] In doing so, resale diverts volumes of material from the landfill. Reducing the volume of retail products sold "may sound like an ax to profit, but in a circular economy, it's about generating more money from the same products [while also] leaning into materials like recycled wool that are actually cheaper than their virgin counterparts."[158]

An additional benefit of pursuing resale is the chance for new engagement with customers. Through the sale of second-hand garments, brands can reach customers they might not have been able to otherwise, they can offer an entry-level price point that makes products accessible to a wider consumer base, and they can provide services that enable them to interact with customers beyond sales.[159]

Types of Resale Models

Four main categories exist in terms of clothing resale business: peer-to-peer marketplaces, managed marketplaces, managed brand-owned, and peer-to-peer brand owned (6).[160] These distinct models are important to recognize for taking different approaches that bring about circularity principles.

Fully **peer-to-peer marketplaces** are platforms for individuals to buy and sell directly to one another, independent of any processing by a company between them. A platform like eBay can be recognized as a business that pioneered the peer-to-peer marketplace model. Beyond

[157] T. Hill (personal communication), 14 Apr 2023.
[158] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.
[159] T. Hill (personal communication), 14 Apr 2023.
[160] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

eBay, some of the more contemporary, popular peer-to-peer models for clothing resale include Poshmark and Depop (6).[161]

Managed marketplaces are those in which a company facilitates the movement of garments from seller to buyer. This typically looks like collecting a variety of garments, by style or brand, processing the inventory by sorting, cleaning, digitizing, and posting the items on a platform for re-purchase (6).[162] ThredUp is one example of a managed marketplace.

Managed brand-owned programs are those in which a company or third-party operator collects pre-owned garments, processes them, and posts them for resale on the company's website (6).[163] The companies evaluated in this study – Patagonia, REI, and Cotopaxi – all fall under this category, each partnering with Trove to implement logistics and provide the necessary services for trade-in. In comparison to marketplace programs like eBay, brand-owned resale is a relatively new development that consumers may lack familiarity with because it is still gaining traction. When looking at the current state of resale businesses, the key themes that emerge for overall success for managed-brand owned programs are scale, commerce integration, and ease of trade-in or selling (20).[164]

Like the name of the model suggests, a **peer-to-peer brand-owned** platform allows customers to buy and sell directly to each other within a branded environment (6).[165] This looks different from peer-to-peer marketplaces because, within a brand-owned model, consumers can shop pre-owned products from a brand they already know and love. Upon receiving a purchase, buyers will receive inventory coming from an individual seller, not the company itself. This

[161] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[162] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[163] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[164] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[165] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

model provides a much more direct experience for consumers seeking second-hand items from a specific brand because it eliminates the need to dig through marketplaces where it is not guaranteed products from a certain brand are available. However, because it is peer-to-peer, the touchpoints where a company can process the item and ensure its quality are lost.

Components of a Successful Resale Strategy

Combining key indicators for success from reports by Accenture and Trove, an exceptional model to recover products for resale contains components in the following five categories: service offerings, systematic cohesion, seller experience, buyer experience, and marketing.

Service Offerings

A company should prioritize aligning its sales model with principles and incentives outlined by the circular economy model (27).[166] A shift in focus, from sales to service, would mean that products are no longer owned but rather leased by a customer, using an item until replacement is needed. In the application of apparel, this metric further raises the need for durable, long-lasting goods by design; leasing makes sense in the long-term, and rental service would be more fit for apparel with one-off or rotational uses.

Services must also be provided to help consumers access maintenance, repair, upgrades, and reuse to prolong a garment's use (28).[167] A successful resale model will ensure that all possible touch points of consumer need are addressed. If services cannot be made available on a local scale, companies should incentivize them through mail-in programs. Not to mention, it is

[166] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[167] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.

critical that repair services are affordable and accessible to further encourage their use by consumers (28).[168]

Systematic Cohesion

After all primary efforts have been made to keep a product in the same customers' hands, a comprehensive collection network is the next necessary element for successful resale. Of course, take-back channels will vary depending on the customer segment, downstream costs, and the local infrastructure. In any case, we should work towards ensuring that "every consumer has easy and convenient access to a collection pathway" (32).[169]

Collection touchpoints create additional costs by requiring the collaboration of all actors involved in reverse-logistics; the process must be cost-effective and timely (33).[170] Different mechanisms can be employed to cover the cost of collection: policies like carbon credits, a producer responsibility organization, or legislated extended producer responsibility.[171] are some of the ways this has been accomplished in other industries (32).[172]

Effective processes for sorting, disassembling, and recovering materials must exist for products that have been re-collected. Sorting is dependent on the age, appearance, material composition, and recovery potential of a product; AI and robotics technologies can be deployed to make this stage more efficient and cost-effective (34).[173]

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[168] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[169] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[170] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[171] "Extended Producer Responsibility Program for Packaging." *Extended Producer Responsibility for Packaging, Waste Management, Maine Department of Environmental Protection*
[172] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[173] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.

Collaboration between supply chain actors is equally necessary for a collection network. Recyclers, suppliers, designers, and more must work in unison to create profitable markets so that recycled materials are being re-integrated into new products.

Seller Experience

Consumers must be inclined to give back their products to a collection agent for resale to work (30).[174] Without consumer participation in returning products, there is no supply of pre-owned goods. Discounts, cashback, and other strategies can be utilized by companies to incentivize the trade-in of products. Additionally, multiple pathways for product collection can be utilized to increase accessibility – such as through cities or municipalities, manufacturers, or retailers (31).[175] This metric will be most effective if every stakeholder is involved in consumer education about the specifics of returning products and the importance of doing so.

Explicit terms of trade-in, including key stages and timeline, should be disclosed to the seller (17).[176] The recent influx of companies entering resale markets has created an array of program types, all with slightly different terms of trade-in. Even programs of the same model will have minute differences regarding things like fees and return policies. For example, Lululemon's trade-in program provides customers with immediate credit that can be redeemed that same day, whereas other programs may prolong the time before trade-in credit is valid for redemption (18).[177]

Companies pursuing resale should also be transparent about how they determine value of pre-owned items, so that sellers can form accurate expectations of the compensation they will

[174] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[175] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[176] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[177] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

receive (17).[178] The vast majority (93%) of brands evaluated in Trove's Brand Index study offer gift cards for compensation, whereas others may provide cash. These factors will be considered by sellers when discerning which resale channels to use for returning their products.

Making trade-in available by multiple channels, such as in-store and by mail, will enhance the seller experience by expanding accessibility of drop off points (17).[179] This will also enable sellers everywhere to participate in circular resale practices, regardless of their location. Mail-in is a common feature of collection programs today, with 85% of resale models in the study by Trove offering mail-based selling (16).[180]

Another practice that enhances seller experience, but is less prevalent among current apparel resale initiatives, is the ability to "select from prior purchases for trade-in/selling" (17).[181] Though this is not as likely to influence consumer inclination to return products as is making a service available via mail, it is an additional factor that could strengthen ease of selling.

Buyer Experience

Proving product information – such as name, description, and condition – is a key concern for the resale of pre-owned items (15).[182] Unlike new, retail items, shopping a selection of second-hand garments will necessitate additional considerations; brands can get a step ahead by providing this information, and it should be a common practice. Right now, less than half of the resale programs evaluated in Trove's study allowed shoppers to filter their search by condition-related qualities (13).[183]

[178] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[179] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[180] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[181] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[182] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[183] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

Proving clear terms of buying second-hand, including a return policy, also makes for a successful buyer experience (15).[184] Return policies and related terms are commonplace when we shop retail, so it makes sense to extend this practice and create a congruent purchasing experience for used goods.

Further, the ability to shop new and pre-owned items on the same webpage creates an integrated shopping experience for customers (15).[185] Only 13% of brands featured in Trove's study integrate new and used products in the search results on the main site. Additionally, a similarly low number of programs allow new and pre-owned purchases to be combined into one checkout cart (14).[186] Having a single avenue to shop and checkout for new and pre-owned goods can help further streamline the shopping experience into an easy, cohesive experience that consumers want to partake in.

Another mechanism that contributes to buyer experience is allowing gift cards to be used for the purchase of both new and pre-owned goods. While 93% of the trove-rated resale programs give the option of gift cards for compensation, only 41% allow gift cards to be redeemed for the purchase of used goods (17).[187] With resale encouraging brand-consumer relationships, we can assume that many buyers will also be sellers. Facilitating easy transactions in these ways can better the experience of buyers and make them more willing to return for future purchases.

[184] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[185] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[186] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[187] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

Marketing

To overcome myths associated with secondary resources, companies can tailor marketing to highlight the positive characteristics of circular products: durability, repairability, lower total cost of ownership, lower carbon footprint, and more (26).[188] Greenwashing has been a notable concern around marketing, especially within the apparel industry; but marketing products in a manner that is fact-based and utilizes tools like eco-certifications will help boost credibility (26).[189] Companies pursuing resale have proven to be successful in utilizing existing channels, such as e-mail or social media, to market used goods (12).[190]

Integrating used goods into the main product display page on a brand's website is another effective way to promote resale. A navigable website will provide customers with easily accessible content, increased awareness, and integrated shopping (10).[191] Many companies in the resale space already have hyperlinks to their separate resale e-commerce sites on the main webpage, but only 28% include pre-owned goods as a tab on the main site (10).[192]

The resale of second-hand garments creates an opportunity for storytelling that brands should make the most of (12).[193] Though successful resale will be fully integrated with retail shopping online, selling used garments may present a challenge to the way consumers receive information. Companies can create resale-specific branding to communicate the purpose of the program and link it back to any mission or values the organization may have. In Trove's study, Patagonia scored the highest in brand positioning because its Worn Wear program is promoted

[188] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[189] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[190] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[191] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[192] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[193] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

by marketing it as better than new. The company's marketing strategy also includes a blog called "The Stories We Wear" that features firsthand accounts of pieces submitted to worn wear by customers and descriptions of adventures people took their garments on (11).[194]

A successful marketing strategy for resale will also ensure that brand and retail employees are educated on the trade-in initiatives.[195] This is especially important for programs that offer in-person selling, but is a fundamental practice

Company Case Studies: Resale Strategy

Trove: A Resale Provider

Trove is an operator that helps companies implement reverse logistics and establish take-back platforms for the resale of pre-owned garments. The company was founded and established as a certified B-Corp in 2016.[196] Many big names in apparel, including companies like Levi's, Lululemon, and Eileen Fisher, are all using Trove's services to integrate the reverse logistics necessary for trade-in. In total, Trove has acquired and implemented resale platforms with thirteen brand partners across different verticals of apparel.

All of Trove's resale storefronts happen on their partner companies' websites, a typical occurrence of managed brand-owned platforms. All three brands in this study – Patagonia, REI, and Cotopaxi – have partnered with Trove to implement managed brand-owned resale models in which they collect, clean, digitize, and resell used garments under the brand's domain. By nature of being in the outdoor gear and apparel industry, brands are "well positioned for success in the

[194] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[195] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[196] "Who We Are" *Trove*, n.d., https://trove.com/who-we-are/

resale space since there is a natural alignment between the resale mission and customer values, the durability of products, and higher-priced items" (7).[197]

Worn Wear: Patagonia's Resale Business

Patagonia is a pioneer in the resale space, being one of the first of its kind where customers could shop second-hand clothes online. In 2011, the company rolled out its Common Threads Initiative which included a platform for resale on the eBay site.[198] Taking the form of a peer-to-peer brand-owned model, this initial resale program enabled Patagonia customers to buy and sell used gear to one another directly via the eBay storefront.[199] The company provided a hyperlink to the eBay site on their main webpage, under a tab titled "Used Clothing & Gear." This program proved successful for Patagonia with over 53,000 pre-owned garments resold through the platform.[200]

Although the company had an established platform for resale – one that was successfully redefining the relationship between its customers and the consumption of its products – the brand decided to switch gears. Patagonia partnered with Trove to pivot their resale strategy away from the Common Threads peer-to-peer brand-owned model, and instead transition to a managed brand-owned model called Worn Wear. This new resale program was launched by Patagonia and Trove in April of 2017.[201] Worn Wear functions as its own website, separate from Patagonia's main site, but connected through hyperlinks and a tab where customers can click to browse used goods. Today, Worn Wear accounts for $5 million of Patagonia's total business.[202] Though this

[197] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[198] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.
[199] "Patagonia + eBay Expand Common Threads Partnership to UK" *eBay Stories*, eBay, 13 May 2013.
[200] "Patagonia + eBay Expand Common Threads Partnership to UK" *eBay Stories*, eBay, 13 May 2013
[201] "Who We Are" *Trove*, n.d., https://trove.com/who-we-are/
[202] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.

is one of the largest and most successful resale platforms in the outdoor apparel and gear space, that sum remains a small fraction of Patagonia's revenue from the sale of new items.[203]

Apart from resale, Patagonia is currently expanding a rentals initiative in which customers can use gear in a more service-based model; as it stands, Patagonia's rentals only apply to gear for mountain biking, hiking, and fly fishing, so it is not yet relevant to apparel.[204] One of the hallmarks of Patagonia's identity is the company's commitment to long-lasting gear that consumers can bond with, making a lifetime of memories in outdoor pursuits. The Ironclad Guarantee warranty provides an array of services for customers to maximize use of their product.[205] To name a few, Patagonia has a repair kit they send upon request by customers wishing to perform minor repairs themselves, and online tutorials are available to guide customers through product care and repair.[206] The brand also offers repair services performed by in-store Patagonia staff, or customers can opt to mail-in products to the repair team in Reno, Nevada.[207] Offering repair services for free, while having multiple avenues available for customers to access such services, are highly aligned practices with circularity and seek to engage customers in the circularity endeavor as well.

Patagonia continues to lead the pack when it comes to sustainability in apparel; it is notable that a brand of Patagonia's size and status is simply acknowledging the fact that "the crux of circularity isn't take-back programs, it's rethinking how products are conceptualized to begin with."[208]

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[203] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.
[204] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.
[205] "Repair Process." *Patagonia*, n.d., https://help.patagonia.com/s/article/Repair-Process
[206] "Care & Repair." *Patagonia*, n.d., https://www.patagonia.com/repairs/#video-guides
[207] "Repair Process." *Patagonia*, n.d., https://help.patagonia.com/s/article/Repair-Process
[208] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.

Re/Supply: REI's Resale Business

In October of 2017, the Re/Supply resale initiative was rolled out of a partnership between Trove and REI Co-Op.[209] Re/Supply is a membership-based platform, where only REI Co-Op members can participate as buyers and sellers of used gear.[210] Trade-in is offered both by mail and in-person, available at any REI store locations. In this model, the value of trade-in is dependent on condition and credit is received as a gift card. Co-op members also receive access to a 10% bonus on trade-ins to further incentivize the circulation of pre-owned goods.[211]

The Re/Supply program accepts a wider selection of garments for trade-in – including both REI-brand products as well as items from competing brands like Patagonia, Cotopaxi, and the North Face – as long as the products have previously appeared in the company's vast product catalog. In comparison, other resale initiatives rolled out by Trove's partner companies only accept manufactured goods produced by their respective brands. This key distinction comes from the fact that REI is simultaneously a brand and a retailer. REI also has the most expensive product offerings outside of apparel; the company's trade-in program is expanded to include gear like sleeping bags, tents, hiking boots, and even bikes.[212]

Acting as a brand and retailer provides REI with a competitive edge in resale, being a one-stop shop for customers looking to trade in a variety of outdoor gear from different brands. REI's trade-in catalog shows that it accepts over 90 brands of jackets alone, and the trade-in service is expanded beyond apparel.[213] The company's revenue from its used gear business saw

[209] "Who We Are" *Trove*, n.d., https://trove.com/who-we-are/
[210] "REI Co-op Reports Strong Growth in 2021, Setting Co-op Record in Membership." *REI Co-Op Newsroom*, REI Co-Op, 12 Apr. 2022.
[211] "REI Co-op Reports Strong Growth in 2021, Setting Co-op Record in Membership." *REI Co-Op Newsroom*, REI Co-Op, 12 Apr. 2022.
[212] "REI Co-op Reports Strong Growth in 2021, Setting Co-op Record in Membership." *REI Co-Op Newsroom*, REI Co-Op, 12 Apr. 2022.
[213] "FAQ: Trade-in - How It Works." *REI Used Gear*, REI Co-Op, n.d.

an 86% increase in revenue in 2021 alone, from just one year prior.[214] And as resale begins to take up larger shares of apparel markets each year, we can predict REI's Re/Supply program to continue growing. REI's duality as a brand and retailer accepting trade-in also poses further questions that frameworks like carbon accounting are not equipped to answer. If REI takes back a Patagonia t-shirt, which company gets to account for those savings in resources, emissions, etc. in tracking their environmental footprint?

Outside of resale, two main initiatives by REI that complement the life-extension phase of circularity are the company's gear rental program and maintenance services. Providing repair services is becoming more and more popular in outdoor apparel, but since REI's product selection goes far beyond apparel, the company has also extended its maintenance services to address non-apparel goods like bikes.[215] REI's rental offerings, as they currently stand, include non-apparel items such as skis and tents. The company's marketing materials provide no sign of intention to integrate apparel into the product offerings for rental.[216] However, making outdoor apparel available through rental is an effort that REI could pilot since not many actors have tried and REI already has an operating model for gear rentals.

Recommerce: Cotopaxi's Resale Business

Cotopaxi's resale platform with Trove was rolled out in June 2021.[217] Contrary to Patagonia and REI's trade in models, Cotopaxi's trade-in initiative is available by mail only. To send in products, sellers have the option to receive a pre-paid mailing label or an entire shipping

[214] "REI Co-op Reports Strong Growth in 2021, Setting Co-op Record in Membership." *REI Co-Op Newsroom*, REI Co-Op, 12 Apr. 2022.
[215] "Rentals" REI Co-Op, n.d., https://www.rei.com/rentals/pricing
[216] "Product Impact and Re/Supply." *REI Stewardship*, REI Co-Op, n.d.
[217] "Who We Are" *Trove*, n.d., https://trove.com/who-we-are/

kit with packaging provided. The packaging kit provides an extra measure of convenience for customers but deducts a flat fee of $6 from all trade-in submissions to cover shipping costs. [218]

This trade-in model enables sellers to "get an up-front estimate of the trade-in value" of a garment online, however the actual trade-in value is decided upon inspection after items have been submitted. [219] Cotopaxi evaluates its used goods by condition, falling into categories of excellent (practically new), lightly worn, moderately worn, or well worn. In addition to condition, the eligibility requirements for trade-in items are that the product is fully functional, free of odors and stains, has no major damages or missing pieces, no alterations, and has been sold by Cotopaxi in the past 6 years. It remains unclear why that is the chosen timeline for trade-in [220]

Cotopaxi provides compensation to sellers via e-gift card for store credit only. Using the trade-in search bar, I plugged in the two Cotopaxi products featured in the product analysis to get a value estimate. The Cielo Rain Jacket, which retails at $145, would receive an estimated $23 in credit, while a cotton t-shirt that is sold at $35 would receive $5-6 for trade-in.[221]

The company expects 7-10 days for processing, from the time its warehouse receives an item to sending out trade-in credit. For items that cannot be accepted for resale, Cotopaxi claims to "look for the next best use," which for them means donation or recycling. There is no current disclosure of specific partners or programs where they donate or recycle unusable materials.[222] The resale of used products is one piece of Cotopaxi's Guaranteed for Good initiative, which also includes other strategies like extended warranty and repair service.[223]

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[218] "Gear & Equipment Trade-In." *Cotopaxi*, Cotopaxi and Trove, n.d.
[219] "Gear & Equipment Trade-In." *Cotopaxi*, Cotopaxi and Trove, n.d.
[220] "Gear & Equipment Trade-In." *Cotopaxi*, Cotopaxi and Trove, n.d.
[221] "Gear & Equipment Trade-In." *Cotopaxi*, Cotopaxi and Trove, n.d.
[222] "Gear & Equipment Trade-In." *Cotopaxi*, Cotopaxi and Trove, n.d.
[223] "Guaranteed for Good™." *Cotopaxi*, n.d.

Resale Analysis

Resale is a compatible option for everyday-wear garments that consumers are looking to own, whereas alternative models like clothing rental services are more common for occasional garments and high-end luxury pieces.[224] Resale offers a promising strategy for outdoor apparel brands looking to reduce their environmental footprint because these garments fit into the everyday-wear category that consumers are looking to own rather than rent. However, resale operations for trade-in, processing, and selling must be happening at scale for a brand to realize these benefits (20).[225] Despite the growing sum of businesses entering the resale space, there remains a low level of sales revenue from brand-owned resale programs, when compared to the brands' retail sales. This implies a need for specific marketing to get these programs to a place where they can draw away enough purchasing from retail to have a substantial impact.

Two distinctions can be made within resale models in terms of consumer engagement: consumers looking to sell pre-owned items and consumers looking to buy. Second-hand clothing has a growing appeal to consumers both economically and environmentally; it is drawing more of consumers' apparel budget away from new items as it provides a lower-cost alternative for those looking to shop more sustainability by giving garments a new life.[226] Consumer purchasing within second-hand apparel markets is primarily driven by value, quality, selection or availability, and convenience of buying. In the U.S., online resale is expected to reach $38 billion by 2027, growing at a rate of 21% over the next five years.[227] And businesses already in the

[224] "Putting the Brakes on Fast Fashion." *UN Environment Program*, United Nations, 12 Nov. 2018, https://www.unep.org/news-and-stories/story/putting-brakes-fast-fashion
[225] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[226] "Resale Report 2023." thredUp, 2023.
[227] "Resale Report 2023." thredUp, 2023.

resale market are finding that a significant return-on-investment when using existing communication channels with consumers to market such trade-in initiatives (20).[228]

On the flip side, there is less research that digs into why consumers with trade-in items might choose one resale channel over another.[229]With resale models rising in popularity, is it likely that customers will seek out different types of resale programs for varying reasons. The distinctions among these four resale models indicate different impacts on consumer relations, product offering, quality assurance, and environmental issues. How can a brand incentivize a customer to bring their unwanted t-shirt back to the company rather than listing it up on a marketplace program? The diversity of resale channels means that consumers have autonomy in choosing what trade-in market to interact with. Apparel brands who decide to take up brand-managed resale can benefit in terms of brand image, ensuring quality and cleanliness of goods, while also marketing the enhanced buyer and seller experience that results from brands facilitating these touchpoints.

In the context of outdoor gear apparel, resale seems to make the most sense for technical products; or rather, existing products in the technical sphere are better suited to stay circulating through resale channels for longer. A rain jacket is inherently more durable and thus will last for more consumers before getting so run down than a cotton shirt will. The speed at which garments get worn down, in either sphere, will also be affected by consumer willingness to care for the product and utilize repair services that companies would be providing. Companies must consider and employ strategies to incentivize the use of product upkeep services.

[228] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[229] T. Hill (personal communication), 14 Apr 2023.

Textile Recycling Initiatives & Complications

Overview

The Recycling Business

Recycling is a critical capability that underpins the circular economy. It enables us to break down unusable or discarded materials, use waste as a resource, and reintegrate it back into the economy. Apart from waste diversion and conversion, recycling is also an essential service for managing raw materials and minimizing the risk of resource scarcity (30).[230] It has a fundamental role in reducing the environmental footprint of apparel from water use to GHG emissions, chemical use, and more by decreasing the necessity for new material production. But, to take on that role, it must be driven by goals to maintain high quality materials and reduce environmental impact – rather than being an "afterthought."[231]

Recycling is a major blind spot of the textile industry at large, with current systems that are not equipped to handle the volume and types of material that exist. Since apparel brands cannot undertake an endeavor like recycling themselves, mostly due to the magnitude of industrial textile recycling, there is a clear need for more industry collaboration in which brands work with suppliers towards a collective goal.[232] It is important to note, however, that recycling is considered a "last resort" tool for the circular economy because "it means losing the embedded value of a product by reducing it to its basic materials."[233] Even so, current recycling practices and technology are far from adequate for the mixed materials found in most garments, and

[230] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[231] Morseletto, Piero. "Targets for a circular economy." 2020.
[232] T. Hill (personal communication), 14 Apr 2023.
[233] "The Technical Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.

largely insufficient for the amount of clothing waste that exists in our world today due to overproduction (51).[234]

Types of Textile Recycling

Recycling can happen as a mechanical process, a chemical process, or a biological process. These are important to consider because different material types need different forms of recycling and there is a wide variety of materials in garments today. In mechanical recycling, methods like shredding and reprocessing breaks down waste "into secondary raw material or products without significantly changing the chemical structure of the material."[235] Chemical recycling does change the compositional structure of a material by using solvents, chemicals, or thermal processes to break down materials at the molecular level. Biological recycling refers to the composting or digestion of biodegradable waste, a treatment that uses microorganisms, enzymes, and other organic materials to decompose materials.[236]

There are four main levels at which recycling can occur: primary, secondary, tertiary, and quaternary. Primary recycling is a closed-loop process – what we aim for in circularity – in which materials are reprocessed while retaining equivalent or improved properties.[237] The term "properties" here, you can think of as synonymous with material quality. Whereas primary recycling maintains the integrity of a material, secondary recycling reprocesses materials into a product of lower value. Secondary recycling is thus referred to as downcycling or downgrading.[238] Tertiary recycling goes beyond secondary recycling by structurally breaking down a material to its core components. In practice, tertiary recycling recovers embodied

[234] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[235] "Textile Exchange Guide to Recycled Inputs." *Textile Exchange*, 22 Sep. 2021.
[236] "Textile Exchange Guide to Recycled Inputs." *Textile Exchange*, 22 Sep. 2021.
[237] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018
[238] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018

resources such as chemicals or water [239]. And lastly, quaternary recycling entails recovering energy from materials – so think incineration.

Material-Specific Recycling Complications

Issues in Recycling Materials

Current textile recycling technology is challenged by a variety of materials that are mixed to create one garment. As previously noted, the efficiency of a circular economy depends on the ability of that economy to separate biological and technological nutrient spheres and keep them distinguished (14).[240] Apparel garments are commonly made from fabrics that blend biomaterials with synthetics; separating them is difficult, yet it is a prerequisite for efficient, scaled recycling. Nutrient sphere separation – like keeping cotton away from polyester – is partially a function of design, but advancements in recycling can help resolve this where there is an absence of incentive to remove them in design due to trade-offs in other desirable traits.

Around 66% of fiber used in the apparel industry come from synthetic fabrics, despite brands' claims to utilize sustainable materials (35).[241] Outdoor garments, like fast fashion products, largely contain inorganic and synthetic clothes, meaning they are non-biodegradable. In fact, when these clothes are left, their material composition cannot break down and instead releases often hazardous chemicals into the surrounding environment (50).[242] If technical materials like synthetic fabrics are not "being maintained for their reuse cycle, they are commonly smashed together into monstrous hybrids. They get dumped into the biosphere. As

[239] Bocken, Nancy M. P. et al. "Product design and business model strategies for a circular economy." 2018
[240] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[241] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[242] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.

soon as you let the next big thing into the biosphere, it's a neurotoxin" (54). [243] Refining what we think of as a "sustainable" material is critical when addressing the caveats that exist, especially when evaluating the lifecycle impacts of synthetic fabrics. In addition to mixed materials, recycling is equally difficult for low grade materials (58)[244]. To achieve a circular economy necessitates the use of quality materials that can withstand several rounds of recycling without losing value, or downcycling.

Different market segments within apparel will have varying recycling challenges because they each have different types of materials they tend to work with the most (31).[245] Outdoor gear will look different from fast fashion, which will look different from couture.

Eastman's Molecular Recycling Process

Apart from apparel, looking into how circular practices play out in other consumer-goods industries provides insight to the validity and importance of recycling. Eastman is a well-established business in the eyewear industry, pioneering the development of special materials relevant to eyewear products.[246] This company innovated a new technology that allows plastic waste to be broken down into molecules, from which new materials can be rebuilt. By reducing plastic materials to the molecular level, they can access the same molecules that go into conventional plastics. This means that recycled material becomes identical to the virgin material Eastman was previously using.[247]

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[243] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[244] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[245] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[246] Anderson, Deonna. "Circular Fashion Starts at the Beginning: An Eyewear Case Study." GreenBiz, uploaded by GreenBiz Webcasts, 18 Oct. 2022
[247] Anderson, Deonna. "Circular Fashion Starts at the Beginning: An Eyewear Case Study." GreenBiz, uploaded by GreenBiz Webcasts, 18 Oct. 2022

These recovered plastics have been integrated in their products in three main forms: Acetate Renew is in their optical frames, which use about 40% recycled content; Tenite Renew is also used in their optical frames, at about 50% recycled content; and Tritan Renew is the material used for their sunwear frames and lenses. Developing this transformative recycling process has proven immensely beneficial for Eastman in terms of consumer response, as it allows them to use materials that perform the same as their conventional materials – i.e., they have come up with a way to eliminate trade-offs that come with a sustainable alternative, such as quality.[248]

After rolling out new products that integrate the aforementioned materials, Eastman conducted a survey of consumer expectations and experience with the new products. This study found that 74% of consumer respondents consider the key definition of a sustainable product is the materials it is made from, while 42% of consumers look for eco-certifications to discern where to place their trust with a brand claiming to be eco-friendly.[249] Eastman also found brand positioning to be a profitable, competitive edge in markets where there is a heightened demand yet minimal options for eco-friendly products that prioritize sustainability without compromising on other factors such as quality and price.

Although this study focused on markets for sustainable eyewear, there are some general takeaways that can be drawn to the context of apparel. One of the factors that underpinned Eastman's success shifting its products away from virgin materials was "educating the whole ecosystem." The company made substantial efforts to ensure the company's employees, partners, and consumers understood the transition and provided robust information at the product level for all stakeholders. With a level of clarity established, Eastman also found that people will buy products with recycled content so long as they don't compromise on the baseline quality,

[248] Anderson, Deonna. "Circular Fashion Starts at the Beginning: An Eyewear Case Study." 18 Oct. 2022
[249] Anderson, Deonna. "Circular Fashion Starts at the Beginning: An Eyewear Case Study." 18 Oct. 2022

durability, and price that they are used to getting with the original product. Lastly, sustainability helps attract consumer loyalty which makes it worthwhile from a business standpoint; if consumers care, pursuing strategies to minimize product impacts will only multiply the benefits of doing so.[250]

Opportunities in Recycling Materials

Due to the barriers posed by contemporary recycling systems and technology, transitioning to circular apparel should prioritize a phase out of mixed materials and low-grade materials in garments. This can be coupled with R&D to advance recycling and adjacent practices for apparel, such as product identification. Together, these efforts can help recycling function at an increased level and innovate better technology to optimize recycling further.

To work with the recycling infrastructure currently in place, keeping materials in their respective spheres when possible is critical. Recycling always circles back to design, the touchpoint where a brand decides whether to have a products end-of-life stage in mind. Keeping materials separate will depend on the decisions of brands' design teams; however, the Eastman study demonstrates that there is business value in choosing better materials – "better" meaning more sustainable, recycled, non-toxic, or in this case, materials purely on the biological or technological side. Doing so will leverage the capability of the recycling systems we do have to start making progress.

When trade-offs arise with bio-based garments – those made from cotton, wool, hemp, etc. – circular design should aim primarily for recyclability. This is because fully bio-based products can be composted and recycled through natural processes like anaerobic digestion.[251]

[250] Anderson, Deonna. "Circular Fashion Starts at the Beginning: An Eyewear Case Study." 18 Oct. 2022
[251] "The Biological Cycle of the Butterfly Diagram" *Circular Economy*, Ellen MacArthur Foundation, n.d.

Of course, they should be kept in circulation for as long as possible as garments, but since these materials biodegrade it is less of a worry in the event they do not last forever; if they are made in a clean process, they can break down and return nutrients to the environment, and be re-created with that same clean process. Yet this requires additional steps in the circularity toolkit, such as eliminating chemical dyes and utilizing renewable energy in manufacturing.

Whereas biomaterials can be repeatedly broken down and re-created, circular design for synthetic garments should prioritize durability and long-life. As previously discussed, these materials cannot break down and tend to contain more harmful substances; keeping them in circulation through different markets – for example reaching multiple consumers through multiple resale channels – may be more effective than efforts to break them down through recycling. For both nutrient spheres, it is critical to implement the systems and services necessary to maximize the number of users per product and uses per user. This is where interventions like resale come into play, so that recycling is used only as a last resort option for the unwearable, unrepairable, and unusable products.

Waste Pathways

Existing Pathways

The circular economy model posits that optimal and efficient loops have all products being recycled back into the same application. In apparel, this would mean all clothing is made from previous clothing waste, and clothing waste is only going into the creation of more clothing.[252] As our economy currently stands, recycled materials flow in and out of different waste streams. In apparel, recovered material inputs often originate from things like recycled

[252] T. Hill (personal communication), 14 Apr 2023.

plastics, rather than material from recycled garments. The current applications of textile waste, as an output, depend on the distinction between pre- and post-consumer waste (37).[253] Pre-consumer textile waste has been used for carpet underlay, mattress filling, shoe soles, and more. Postconsumer sources of textile waste may go towards applications like cloth backing, patchwork, bed sheets, or dye pigments (37).[254]

Downcycling is what occurs when value is lost in the process of recovering materials (43).[255] This phenomenon poses a barrier to circular practices as "a general prerequisite for closed value chain loops is that the quality of the materials does not deteriorate more than slightly during recycling" (21).[256] Many garments today contain a variety of fibers merged together to create a hybrid fabric that can provide breathability among other desired qualities; yet current recycling technology is not equipped to handle mixed materials because it cannot recognize the makeup of a garment's contents (51).[257] Without adequate recycling to re-spin discarded clothes into new fiber, clothes are bound to be downcycled/ The recycling market is currently dominated by low quality, low cost textiles because of financial incentives (58).[258]

Apparel also experiences a flow of material value going in the opposite direction – a process known as upcycling. Upcycling is an innovative solution for textile waste that has risen in popularity, especially among younger generations that frequent thrift stores and make up large segments of second-hand clothing markets. Rather than high quality materials being

[253] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[254] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[255] Braungart and McDonough. *The Upcycle: Beyond Sustainability -- Designing for Abundance*. 2013.
[256] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[257] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.
[258] Pandit, Pintu, et al. "Recycling from Waste in Fashion and Textiles: A Sustainable and Circular Economic Approach." 2020.

downgraded, upcycling takes low quality materials that have lost value and re-creates them into a value-added product.

Circular Pathways Looking Forward

Circular economy theorists have outlined pathways for where discarded clothes and waste should go, coinciding with the four types of recycling (primary, secondary, tertiary, and quaternary). These can be seen in the figure below, which outlines a typical recycling system. I have delineated the four levels of recycling by their corresponding number. When two numbers are found at the same stage in the recycling diagram below, the key differentiating factor is how much a material has maintained its quality and integrity by that point.

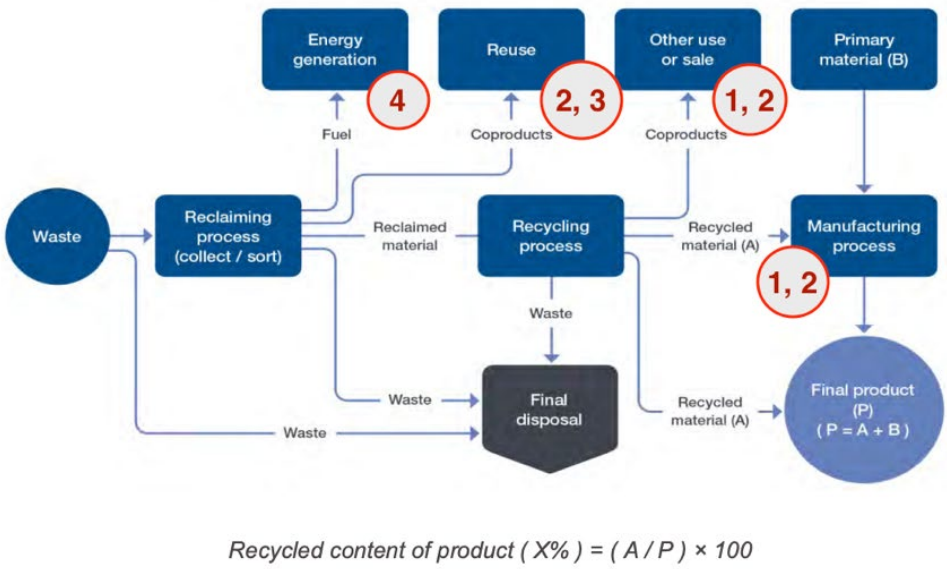

Figure #5: Simplified Recycling System [259]

[259] "Textile Exchange Guide to Recycled Inputs." *Textile Exchange*, 22 Sep. 2021.

Recycling is a last resort option, but, when necessary, it should happen in the order of primary to quaternary recycling. By prioritizing recycling pathways in this manner, after all other potential applications have been expended, the circular economy retains the highest quality and value of materials for as long as possible; it deploys pathways that guide materials in an energy efficient process (38).[260] To establish a circular economy in apparel, it will be important to innovate solutions to downcycling and leverage upcycling where possible. Ideally, all apparel would be used as input for new apparel; it would be most efficient to have clothes only be made from old clothes.

But in a world like ours today, with large amounts of single-use plastics and waste from other consumer goods, there is room to integrate recovered materials from other sources into apparel and to use recovered apparel waste as inputs for other products. If this occurs, the circular economy model will look more like the second version of the diagram pictured below. The first circular economy projects, such as Patagonia's recycled fleece garments, have realistically achieved a model that closely resembles this.

[260] Korhonen, Jouni, et al. "Circular Economy: The Concept and Its Limitations." 2018

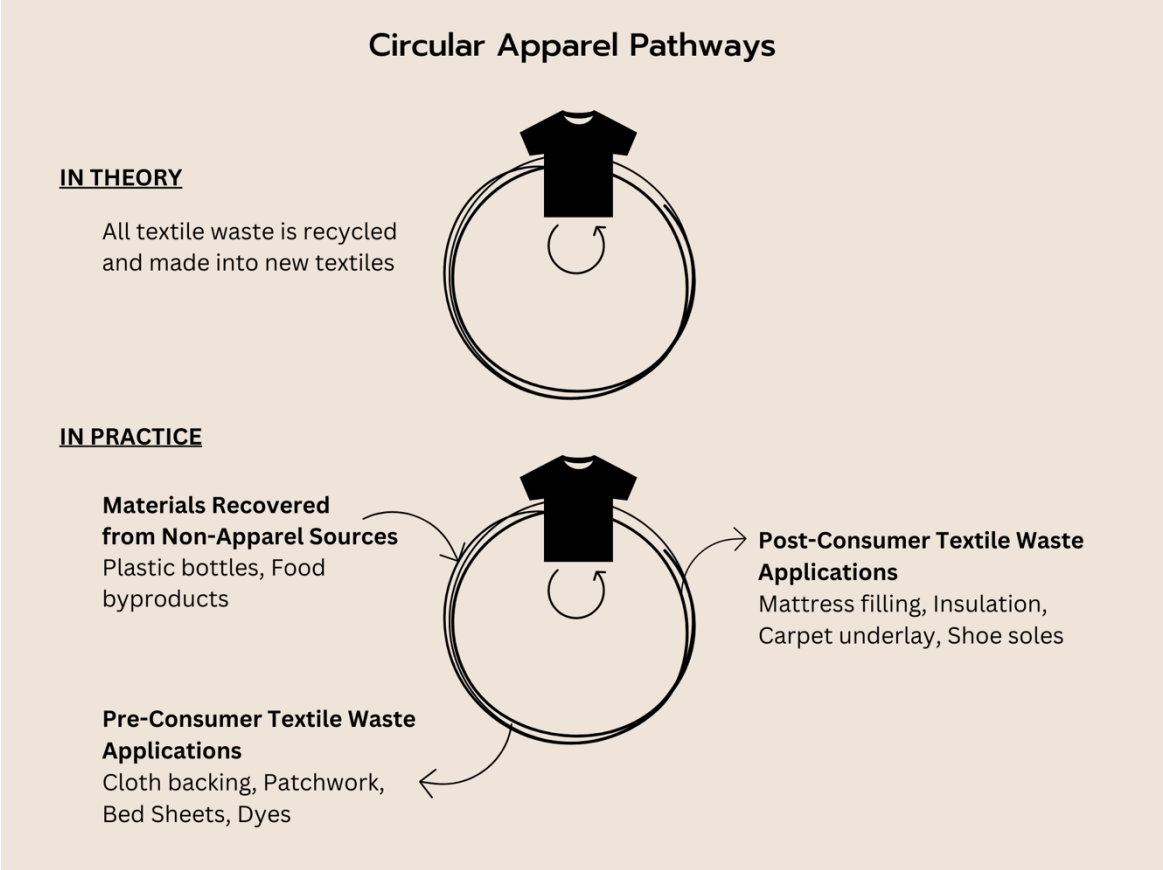

Figure #6: Circular Apparel Pathways

Scale

Issues with Scale

The United States has historically shipped millions of tons of waste material overseas, including end-of-life products in both trash and recycling. This phenomenon primarily happens due to incentives of low-cost economies found outside the U.S. Yet, shipping a massive amount of waste to a place where it can be recovered at a lower cost may create more environmental impacts that outweigh the benefits of recycled material (21).[261]

[261] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.

When looking at industrial recycling systems within the U.S, these operations can occur at a regional or centralized scale (33).[262] The scale at which recycling occurs is an important consideration because it will affect factors of cost and recovery time. Local recycling operations can be beneficial because it reduces the need for goods movement, thus lowering the recovery time and greenhouse emissions associated with transportation (33).[263] Centralized recycling, on the other hand, is a more cost-effective option because of the scale of operations. Industrial textile recycling requires extremely large input volumes, taking up to several thousand pounds of material to be economically worthwhile.[264]

Opportunities with Scale

Although cost – the number one driver of for-profit business-decisions – is higher for domestic recycling, a viable circular economy will depend on domestic recycling. Consider this: a shipping container of textiles is sent from the U.S. to China, spun into recycled fabrics, re-manufactured into a garment, and then shipped back to the U.S. It is entirely possible that the carbon footprint of this process will likely create a significant environmental burden that cannot be offset using recycled materials alone. To better balance trade-offs like these, recycling must happen domestically. Another way to achieve an efficient scale of recycling is mono-recycling, or having each plant specialize in one material type.[265] For example, recycling plant A would only accept cotton-polyester blends, while recycling plant B would only take in nylon-based fabrics.

[262] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[263] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.
[264] T. Hill (personal communication), 14 Apr 2023.
[265] T. Hill (personal communication), 14 Apr 2023.

To help fund these operations, policies that are conducive to recycling can help reduce costs and strengthen the infrastructure.[266] An example of one such policy is known as extended producer responsibility (EPR). EPR policies require producers to pay fees which are channeled into funding for recycling costs, infrastructure, and public education.[267] In the U.S, this policy has been employed to address packaging waste in the State of Maine by collecting producer fees which vary according to the amount, toxicity, and recyclability of packing created by each actor.[268] EPR is a model of governance that imposes responsibility and accountability; it could be reflected in the apparel industry to accomplish similar goals of reducing waste and toxicity, while increasing recyclability.

Recycling garments requires cross-industry collaboration, which poses an additional barrier due to the complexity of the apparel value chain. Coordination between consumers for garment supply, brands taking back the products, recyclers doing the technical work, and suppliers retrieving those new materials may prove difficult. There is no precedent to establish what actions should be taken by stakeholder and in what order in a systemic change as big as shifting to a recycling-heavy, circular economy.

To comprehensively reduce material waste at scale, recycling needs to be domestic, efficient, cost-effective, specialized in certain materials, and backed by pre-competitive efforts. With the timely nature of climate change, precautionary efforts should also be taken to avoid possible unforeseen consequences of recycling, such as the previous example with a spike in CO2 emissions due to international shipping. Industry actors must work together with

[266] T. Hill (personal communication), 14 Apr 2023.
[267] "Extended Producer Responsibility Program for Packaging." *Extended Producer Responsibility for Packaging, Waste Management, Maine Department of Environmental Protection*
[268] "Extended Producer Responsibility Program for Packaging." *Extended Producer Responsibility for Packaging, Waste Management, Maine Department of Environmental Protection*

governments, peers, research institutions, and more to innovate technologies and implement infrastructure that addresses these barriers of collecting and recovering materials.

Company Case Studies: Recycling Strategy

Patagonia's Approach to Recovery

Irreparable garments that arrive at Patagonia's facilities for trade-in have one of two fates: the seller can choose to keep the item or let Patagonia deal with it.[269] If a seller does not want the item back, it is not entirely clear where the item goes or what Patagonia does with it. One can assume an irreparable, unusable garment might factor into the Common Threads Garment Recycling Program or other innovative efforts. However, their current use of recycled materials utilizes a few specialized materials as input which implies that there are significant barriers to recycling and finding applications for other fabrics.[270]

The Common Threads Recycling Program is evidence of Patagonia's circular strategies beginning as early as 2005. Drawing inspiration from Braungart & McDonough's book, *Cradle-to-Cradle,* the company set out to make a line of garments that would never reach the landfill. Patagonia started by collecting pre-owned Patagonia base layers as feedstock and teaming up with Teijin, a Japanese recycler, to create recycled polyester.[271] By employing a technology called Eco-Circle, this initiative would, in theory, make use of discarded materials and minimize the need for petroleum that goes into making virgin polyester. In practice, however, Patagonia faced several barriers: they didn't receive enough supply of old base layers, which meant that

[269] "Repair Process." Patagonia, n.d., https://help.patagonia.com/s/article/Repair-Process
[270] "Common Threads Garment Recycling Program." *Patagonia*, n.d
[271] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.

industrial recycling wasn't possible with a low volume of material, plus their recycling partner moved to an economy that regulated waste intake more heavily.[272]

Today, the company admits that "two decades later, even with savvy customers understanding upcycling, even with companies touting their eco-attributes, even with better infrastructure in place, circularity still doesn't figure into most of the clothing industry—not even here at Patagonia." [273]

Patagonia's pursuit of apparel circularity provides valuable insight for the rest of apparel. One significant takeaway is that a big enough supply of discarded material is required to make recycling possible, and economically worthwhile. Additionally, recycling operations overseas can get tricky with changing regulations – especially for an industry like apparel whose supply chain remains entirely complex. Success for recycling will depend on the ability to work with partners in countries where the policy and economy is conducive to taking in and processing waste. And even with all efforts going towards recycling, it still doesn't yet work for all materials. Since recycled content is only being used in a limited number of fabrics, there is a need for more research and development in this area. The last takeaway from Patagonia's case study is that even a progressive, industry leader can lack transparency. This opacity is especially prevalent when it comes to recycling and exactly where unusable materials go when they are collected through trade-in. There needs to be collective action taken to increase transparency in apparel at large, but it is even more necessary to focus those visibility efforts on recycling and end-of-life product management.

[272] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.
[273] Ram, Archana. "Our quest for Circularity." *Patagonia Stories*, Patagonia, 2021.

REI's Approach to Recovery

REI has a robust online presence that serves to educate consumers on product care and pathways for discarding of an item.[274] The company's "How to Retire Your Gear" article outlines several key aspects to make the most informed, sustainable decision with used goods. It provides guidance on how to gauge material condition and suggests upcycling, downcycling, and recycling as effective ways to keep materials in circulation. It also recommends specific companies for consumers to take their gear to – for example, REI suggests going to Alpkit and For Days to recycle down jackets and other technical outdoor apparel. The company also suggests that consumers donate to local organizations or gear swaps.[275] Though REI encourages the responsible disposal of goods, it does not have in-house methods for sending materials down pathways to be recovered outside of consumer education. Implementing pathways to channel irreparable clothing from REI to a recycling facility is critical for improving REI's circularity performance.

In addition to consumer education on recovering clothing waste, REI has an overarching goal of becoming zero-waste across the company's entire operations by 2025. The company is aiming for reductions in *operational* waste, yet they fail to clearly articulate what is included in that definition. [276] What the company has said around its preliminary zero-waste efforts implies that waste reduction mostly centers around non-apparel items – things like plastics, shopping bags, and paper used in packaging shipments. Still, REI is making progress toward that goal. In 2022, the company reached an impressive 84% of operational waste diverted from landfills.[277]

[274] Daddio, Jess. "How to Retire Your Gear." *Expert Advice*, REI Co-Op, n.d.
[275] Daddio, Jess. "How to Retire Your Gear." *Expert Advice*, REI Co-Op, n.d.
[276] "Eliminating Waste." *REI Stewardship*, REI Co-Op, n.d.
[277] "Eliminating Waste." *REI Stewardship*, REI Co-Op, n.d.

Cotopaxi's Approach to Recovery

Cotopaxi, like REI, is also shooting for reductions in operational waste; the brand "maintained a zero single use plastic policy and transitioned to renewable energy sources or credits across all of our retail stores" in 2022 (38).[278]

Cotopaxi is arguably one of the most proficient brands in outdoor apparel regarding the use of recovered materials in design. The brand released its (Re)Purpose line in 2015 which uses deadstock material that would otherwise be going to landfill. The program has been effectively scaled to date, having now used over 1.8 million yards of "remnant fabric" (37). [279]

While the company is up to speed with materials sourcing as well as repair services, Cotopaxi still may be lacking in the area of recovering its own products at end-of-life. The company has its resale and circular design initiative, but besides that the only product recovery efforts are oriented toward consumer education. The company's website provides recommendations for where consumers can recycle apparel products, similar to REI.[280]

Recycling Analysis

Informational content from brands and organizations in apparel tends to overlook recycling in some cases. Many brands disclose their supplier facilities, but few talk about partnerships they have around recycling or recovery innovation. This may suggest that those efforts have not been made by apparel brands – which is likely the case for some. But it could also mean that any efforts that have been made are too recent or underdeveloped to be in public discourse quite yet. Looking at overall barriers and trends in industrial textile recycling across

[278] "2022 Impact Report." *Cotopaxi*, March 2023, https://cdn.shopify.com/s/files/1/0281/7544/files/Cotopaxi_Impact_Report_2022.pdf?v=1680284982
[279] "2022 Impact Report." *Cotopaxi*, March 2023.
[280] Lee, Cecilia Hae-Jin. "7 Ways to Do a Sustainable Closet Cleanout" *Cotopaxi*, n.d.

scale, waste pathways, and materials helps us think about how recycling might be able to operate efficiently. The figure below recommends actions pertaining to each key barrier, which will be further elaborated on in the coming chapter.

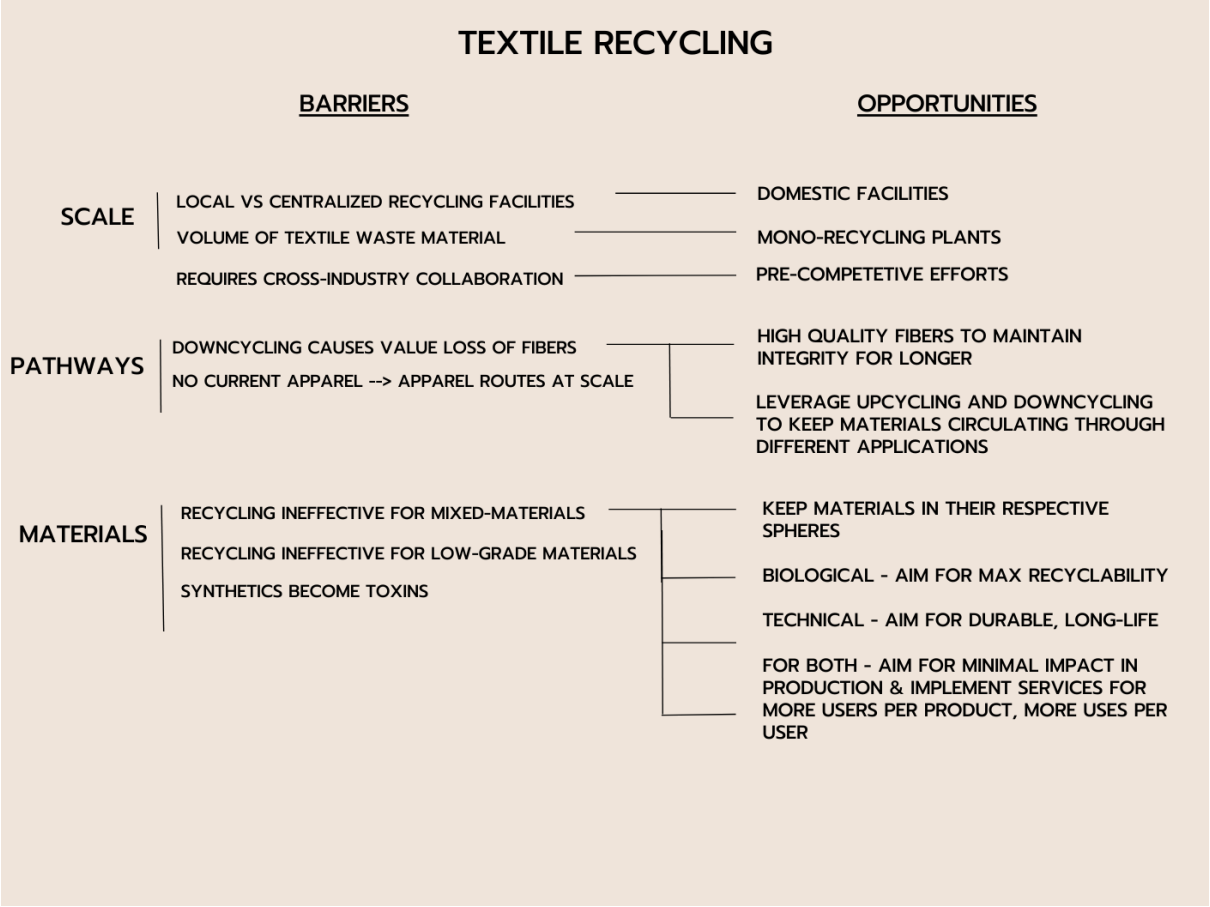

Figure #7: Recommendations for Textile Recycling

Discussion

The way we design and create products is partial to where those products end up at the end of their life – it determines whether garments go from the cradle to the grave, or back to the cradle. Materials selection, resale, and recovery are three approaches in an entire set of circularity strategies that can be used to shift businesses in apparel away from a linear model of production.

Materials Selection

In both biological and technical cycles, circular economy principles emphasize key qualities that all used materials should possess. With garments in both nutrient spheres, we must aim for minimizing the original impacts of production. Product characteristics like durability, longevity, non-toxicity, are desirable traits across the board. However, inherent differences in the material composition of biological and technical garments do influence how they are able to circulate throughout the economy. Because biological materials are highly recoverable (compostable), they are less apt to be long-standing in one state because, in nature, they are needed as food to be consumed by another part of the system, and therefore are constantly shifting in form.

Whereas technical outdoor garments are well suited for more reuse, biological products may have a shorter circular lifespan, especially within resale loops. However, it may not be necessary that they stay circulating in resale forever, so long as the brand develops a plan for enabling the breaking down of bio-based garments and eliminating harmful substances before they can leach into ecosystems. We don't have to be concerned about a banana being single use in the presence of composting, because we know those leftover nutrients will be used by bacteria to nurture the soil; we can think of a cotton t-shirt with non-toxic inputs in the same vein. In

cases like this, we can see how the circular economy idea that the most efficient operation turns all apparel back into apparel need not be strict as there are opportunities to reduce and use waste from other sources.

Materials selection, as one facet of product inputs, will be reflected in the cost of goods. So-called sustainable garments often see a higher price tag because of this–in addition to better pay for garment workers–which can create barriers for lower-income consumers looking to access eco-friendly goods. Mechanisms to price externalities, such as a tax on carbon emissions, are an effective way to attract investment into markets for secondary materials (34).[281] In this way, policies around materials selection can also help increase the profitability of recycling.

Clothing Resale

The existence of multiple, diverse avenues for resale is important to serve different consumer needs in terms of quality, ease, time, and more. Resale also complements other circularity practices; coupled with materials selection, resale addresses the accessibility issue of higher-priced goods by offering second-hand products in decent condition at a discount. Brand-owned, managed programs such as those operated by Trove with Patagonia, REI, or Cotopaxi, are clearly identified and profitable strategies for businesses seeking to implement circularity.

Currently, it is an established practice for each apparel company to employ a brand-specific name for its resale operations, such as Worn Wear or Re/Supply, rather than naming them all Trove programs. This can help enhance storytelling and consumer loyalty; however, it can also create confusion among consumers, especially when programs have different eligibility requirements or trade-in policies. Luckily, operators like Trove implement consistent trade-in

[281] "Circular Electronics System Map: An Industry Blueprint for Action." *Circular Electronics Partnership*, Accenture, n.d.

policies across the brands they work with. But with so many brands entering the resale space–some with Trove's help and many without–it is possible that conversations around resale will become oversaturated with content that all aims for the same purpose.

It is dually important to implement widespread, standardized metrics for tracking the environmental impacts of resale initiatives. Facilitating brand-owned, managed resale creates additional touchpoints that must be quantified: processes like transportation, cleaning, and digitizing are necessary steps to put pre-owned goods back in markets for repurchase. One key metric that can be used to quantify the success of circularity is how much a brand's revenue shifts from the sale of new products to extending the lifetime of existing products (19).[282] Many brands currently have "misaligned incentives" that create barriers to this shift in revenue dependence from new to existing products. For example, giving the option of gift cards for trade-in compensation but not allowing gift cards to be redeemed for the purchase of used goods is contradictory to the overall purpose of resale. Resale is not inherently a sustainable practice on its own, but it must be coupled with disincentivizing new product purchases and decreasing the overall pace of consumption (19).[283]

Brands that are also retailers, like REI, have a unique opportunity when it comes to resale and should lean into that as a more comprehensive means toward impact reduction but while successfully engaging customers. Most brands may not have this opportunity, but they should consider ways to collaborate with large retailers. If a retailer doesn't have an existing trade-in program of their own, brands can use retailers as one of several channels for collection, taking back products to be input into their own brand-managed programs. Collaboration in circularity is

[282] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.
[283] Ruben, Andy, et al. "The Brand Resale Index: Defining the Resale Experience." 2023.

key because it is an industry-wide goal that requires such cooperation and cohesion toward a common objective.

Textile Recycling

Recycling is a critical component of circularity as it enables recovered materials to be looped back into the production of new goods. However, recycling systems, technology, and infrastructure are currently unequipped to handle the volume and types of materials that exist as textile waste.

Recycling is also commonly glossed over in circular economy literature, whereas the stages within design and life-extension are more heavily emphasized. Similarly, corporate apparel discourse has focused more on design and life-extension, while there is a general lack of disclosure and transparency about the recycling piece. Especially regarding end-of-life product management, brands need to become more comfortable engaging in conversations about the importance of recovering materials and progressing recycling systems. The apparel companies featured in this study have become comfortable talking about trade-in initiatives and using marketing to tie resale into company mission. However, it seems as though they have not taken enough accountability beyond resale. Brands cannot undertake recycling themselves, but they can collaborate with recyclers and converse in the space. As a circularity strategy, recycling would benefit and progress from an open discourse among brands and other stakeholder groups.

Comparing linear business to the circular economy model makes it clear that our current apparel system needs standardization, sufficient mechanisms for pricing externalities, and more pre-competitive efforts across the industry and outside of it to be more conducive to successful and profitable recycling. Business and non-business entities must collaborate to progress toward efficient textile recycling infrastructure that can help the industry get closer to circular practices.

Ideally, the apparel industry would be complemented by domestic mono-recyclers and supported by government policies such as EPR. And actors both inside and outside of business are necessary to ensure accountability and transparency around end-of-life product management that traditionally has not been required. Yet, building a sustainable clothing industry is much more than increasing recycling infrastructure and standardization; it is a cultural movement that requires a shift in how we think about consumption and organize consumer goods industries at large.

Conclusion

In today's business world, the circular economy requires major trade-offs. A corporate entity in apparel must prioritize a set of values in circularity that isn't always congruent with traditional ideas of profit-maximization – a pursuit that has led to the prioritization of low costs at the expense of negative environmental and social impacts. The case evidence in this study demonstrates that acting toward circular practices can make sense and add value to business. The circular model itself is conceptually ideal, providing guidance for areas where apparel companies can take responsible action. In practice, however, it fails to advise companies on how to address the gray areas of implementation and navigating trade-offs.

No singular manifestation of circular strategy can achieve circularity in isolation. All thirteen stages of circularity outlined in this study help contribute to circular practices, but they cannot achieve a circular economy independently from one another. Materials selection, resale, and recycling are only three components included within a strategy that encompasses other essential initiatives as well. Besides the thirteen stages outlined in my study, a circular economy transition must also be coupled with environmental policy and regulation, better recycling infrastructure, accessible and scalable tools for monitoring product level impacts across the lifecycle, and other instruments to maintain a consistent discussion around the progression of environmental indicators.

In a world that values collaboration, slow consumption, a pollution-free environment, taking care of material goods, and is willing to rethink consumption for the sake of achieving something greater, the circular economy seems practical; but that is not where we stand today. Circular business cannot exist in an apparel system that contradicts circularity by still relying on fossil fuels and linear consumption. The industry must be conducive to these practices,

incentivizing the participation of all stakeholders that interact with apparel in order to fully realize circular practices. Neither Patagonia, REI, nor Cotopaxi can be circular companies with circular product lines in the absence of a joint effort from consumers, suppliers, spinners, dyers, finishers, materials converters, goods assemblers, trading companies, brands, and retailers alike.

The circular economy model poses the right idea for solving dire issues of waste and pollution within fashion; however, the picture is much larger, and more complex. It is not entirely clear that a fully circular economy for apparel is possible. However, the circular economy model points us in the right direction to implement steps that can reduce environmental impacts in apparel and begin to transform how we experience consumption, even if we never achieve a level of 100% circularity.

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